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STATE INSPECTORS AND GAS COMPANIES.

With the present issue we reprint in full, for the benefit of our readers, the Report of Charles W. Hinman, "State Inspector of Gas and Gas Meters for the Commonwealth of Massachusetts."

We must congratulate the fraternity of the above-named State upon the fact that their inspector appears to be a gentleman who has some knowledge of the subject of which he treats. Our reason for such congratulation is based upon the fact that, in a majority of cases where such officials have existence, they are generally appointed at the instance of some political manager, who seeks to reward an ardent and devoted partisan follower, and who cares but little whether such follower is the possessor of a tithe of the qualifications which would seem to fair-minded men to be necessary to the proper performance of the duties which belong to his office.

The particular report under consideration discloses a state of facts which appears to be somewhat different from the generally-accepted ideas of the average disgruntled gas consumer; and furnishes sufficient proof that the much-abused instrument—the gas-meter—can be fairly trusted to do full justice to the gas consumer, even though that *justice* is sure to be injustice to the gas producer.

While Mr. Hinman, in the main, appears to be willing to do about what is right, his failings always lean to the side of the consumer. In making up his averages of slow and fast meters, he states that a few meters which would not register *at all* were omitted in the second table. Another curious result of his calculation appears in his statement that he found one meter which registered *two hundred and twenty per cent.* slow.

He finds that the average error of all the meters about which complaints were made, was 64-100 of one per cent. against the consumer! We should consider that the average gas consumer of the state of Massachusetts will conclude, from a perusal of this report, that the gas meter is not such a falsifier after all.

Another very staggering fact to the constitutional growler will be apparent when he reads that "in each case, a careful inspection showed the gas to be more than four candles above the legal standard." The Inspector admits that the gas was "fairly well purified."

The most amusing thing in connection with this report (and the same thing will be found in all reports of a kindred character) is the general and unmistakable distrust which is evidenced towards the gas maker. The Inspector is of the opinion that no formal requests should be made by the authorities when they, in their wisdom, deem the gas to be of inferior quality, and wish to have their doubts confirmed or dispelled by the proof of a test.

The reason why the inspector thinks this is that he fears the producer will take advantage of the notification, and instantly turn his energies towards the production of a better light, in order that he may be prepared for the official's visit. The remedy proposed to obviate this evil is that the tests should be made at irregular intervals, and without previous warnings. This is certainly heroic treatment, and would seem to make the inspector's visits somewhat similar to those of a government gauger. The reasons why the managers of a gas company should be suspected of such devious ways would seem to be obvious only to the imagination of a "reform" legislator.

With the rapid spread of knowledge concerning gas and gas manufacture, and the dissemination of information amongst consumers as to the best methods of burning the gas which is supplied to them, and the surety that the methods of manufacture and distribution are conducted upon sound and honest business principles, will soon tend to do away with the old ideas which have been entertained upon this subject; and gas men will be no longer looked upon with suspicion and distrust, but will be hailed by all as the successful dispellers of gloom, and the most advanced champions of universal enlightenment.

It is to be hoped that the future relations which will exist between gas companies and state inspectors will be of a nature better calculated to inspire confidence as to the results obtained. This end, we fear, will not be arrived at until the law makers recognize the importance of the fact that such officials should be fully possessed of the essential requirements necessary to a thorough understanding of the importance of the work which they are to undertake; and also, that a gas maker is simply an honest, intelligent citizen.

When this comes to pass, and we hope it will shortly, the better it will be for all concerned. With fairness on all sides, and with a disposition to do exact justice, the lot of the average gas inspector will not be a very hard one to bear.

[Communicated Article.]

The Bunsen or Blue Light in Family Cooking with Gas.

It is now evident that the use of gas for family cooking will soon be largely extended, and that furnishing the apparatus required for it must eventually become a department in the business of all well-conducted gas companies.

Under these circumstances the question we propose to discuss in this paper, to wit, whether the Bunsen system is adapted to general and continuous use in family cooking with gas, becomes a very important one; as, if that system is adopted by the gas companies in initiating the experiment (as without investigation it probably would be), and afterward would have to be abandoned, the entire enterprise would go with it.

There are at present three systems for using gas as fuel, viz.:

Burning it in a pure state without previous heating—the Bunsen system, to wit; mixing the gas before its issue from the burner with a fixed proportion of air, and afterwards burning the mixture from a perforated pipe; and the superheating and blast system, to wit; superheating the gas in the burner, and upon its issue therefrom subjecting it to a current of heated air—both the burner and the stove containing it being so constructed that all the air used both for combustion and cooking must pass through the flame at its base, where the heat is the greatest.

As compared with the first of these systems the Bunsen is, of course, a great economy. As compared with the last it is not; or, rather, it makes a less perfect combustion than that system does, and from not conserving the heat as well, is inferior to it also in practical effect.

That this inference is just is evident from the following:

In the Bunsen burner the air and gas being mixed previous to combustion, in the proportions required for the best results, all additions of air afterwards are in excess, and the more perfect the combustion at the burner, the stronger will be the currents of cold air rushing into the flame at that point, and the greater the demand upon the fuel in the gas to heat them; whereas, when the gas is expanded by superheating, before it mixes with the air required for its combustion, and that air, also heated, is forced into it as it issues from the burner, the mixture must be more intimate, and the result more perfect, than when both air and gas are used in their normal state, as in the Bunsen burner.

But a deficient economy is not the only objection to that burner. There is another much more serious, and we claim, fatal one. When carbon burns with a limited supply of oxygen there is formed what is known as carbonic oxide—a gas burning with a pale blue flame, odorless, slightly lighter than air, and a virulent poison when taken into the lungs.

Now, the conditions of combustion in the Bunsen burner are precisely what are required to form this deadly gas, and accordingly it is a necessary product whenever that burner is used—hitherto not exciting much attention from its limited use, but certain to condemn it whenever such use is extended to continuous family cooking in close rooms. That the public may judge how far this inference is just, we give the following references:

"It" (carbonic oxide) "is not respirable—more poisonous than carbonic acid—burns with a beautiful pale blue flame."—Silliman's "First Principles of Chemistry," p. 224.

"It is a very poisonous gas acting chiefly on the nervous system, causing giddiness when inhaled, sometimes also acute pain in various parts of the body, and, after a while, complete asphyxia."—Watt's "Dictionary of Chemistry," Vol. I., p. 774.

"Oxide of carbon is not merely passive in not supporting respiration, but is active as a poison."—Regnault's "Ed. of Chemistry," Vol. I., p. 321.

"It acts as a strong poison, producing death when inhaled even in very small quantities."—Roscoe's "Elementary Chemistry," p. 80.

"Carbonic oxidd is much more poisonous than carbonic acid; and the inhalation of air containing one two-hundredths of it for any considerable length of time is said to be fatal."—Wells's "Principles of Chemistry," p. 295.

Can anything be more damaging to the Bunsen system than this record (especially as carbonic oxide, unlike carbonic acid, is lighter than air, and, therefore, is diffused throughout the room, while carbonic acid always sinks to the floor); but if further evidence is required, see the experiments at Providence, reported in the American Gas Light Journal of February 2d, 1877, and what is still more conclusive, note the fact that the chief dealers in gas stoves no longer dare to use the Bunsen burner for heating rooms—a fatal admission against its use in close rooms for any purpose, or in any rooms where several such burners are used at one time in large stores.

H.

Cement for Glass, Earthenware, etc.—Dilute white of egg with its bulk of water and beat up thoroughly. Mix to the consistence of thin paste with powdered quicklime. Must be used immediately.—*Amateur's Handbook.*

Mr Warner's Mechanical Stoker.

An interesting experiment was made on Thursday last, in presence of a large number of scientific gentlemen, at the Jarrow Works of the South Shields Gas Company, with Mr. Warner's mechanical stoker. The repeated attempts, and the as oft repeated failures, to supersede hand labor in stoking gas retorts, have naturally led to a great deal of scepticism on the subject, so much so, indeed, that even practical demonstration of the subjugation of mechanics to this important part of gas making does not induce universal belief that the difficulty has been overcome.

The question which is usually uppermost in the minds of such unbelievers is not, however, whether a piece of mechanism lifts and discharges into the retort a certain quantity of coal, and deposits it inside in such a way as to lead to the best carbonization; but whether the work is executed more expeditiously and more economically than by the old system. This is perhaps a highly practical view to take of the matter, but there is such a thing as slavery, and we cannot imagin any more slavish occupation than the stoking of a bench of retorts by hand labor. The wear and tear of human muscle is something approaching to the inhuman, and if a mechanical contrivance can be obtained capable of reducing this labor to the minimum, or of abolishing it altogether, the inventor deserves the thanks of his fellowmen, and companies owe it as a duty to themselves to introduce the machinery, even although the cost may be something more.

The idea of stoking retorts by mechanical means is as old as the history of gas making itself; but in its earlier days there was not the same knowledge as now of the infinite variety of ways in which mechanics can be made to administer to our daily wants, and, if failure was the result of the efforts of Murdoch, Clegg, and others, there was little to be wondered at. Latterly much progress has been made in this direction, and whether or not more modern inventions are to be considered in the light of successes, time alone will reveal. For several years past, Mr. W. J. Warner, the engineer for the South Shields Gas Company, has been experimenting with the view of producing a mechanical stoker, and his ideas have so far fructified and been carried into practical operation at Jarrow. Mr. Warner is a gas engineer who occupies a high place in the profession. His name is known throughout the length and breadth of the kingdom as the inventor and joint patentee with the Messrs. W. & B. Cowan, of Edinburgh, of the Warner and Cowan meter, and his success in this department naturally excited the hope that his stoker would be capable of taking the place of manual labor. In his efforts Mr. Warner has been ably seconded by the directors of his company, and they cannot be otherwise now that they have placed implicit confidence in his ability to execute the work.

Any attempt to describe such a machine as that invented and patented by Mr. Warner, without the aid of sectional diagrams, must prove defective in many important items; but in another column we have endeavored to convey a general idea of the mechanism and the mode in which it performs its work.

On a reference to these details it will be seen that the retort house would in almost every instance require to be built for the machinery, and where a company is securely established, with efficient plant to meet the requirements of the day, we are afraid difficulty will be experienced in getting that company to adopt the new plant. We would not say that companies and corporations are blind to the good which results from the elevation of the position of their workmen; but they have come to look upon the human stoker as a necessary part of their plant, and motives of economy alone, we are afraid, will induce them to make such changes as will enable them to dispense with hand labor. The question therefore comes to be whether a saving is effected by this machine.

Mr. Warner says that after a six months' practical experience, the saving arising from the use of the mechanical stoker is something like a thousand pounds a year. If he is right in this deduction, the sooner the machine is introduced into every gas works from Land's End to John o'Groats the better it will be for every one concerned.—*Journal of Artificial Light*, Feb. 21.

Connellsville Gas Coal and Iron Company.—A few days ago a meeting of the stockholders in the recent purchases of bituminous coal lands in Fayette county was held. The organization was named the "Connellsville Gas Coal and Iron Company," and officers were elected.

The work of developing the coal land and putting up the coke ovens will be commenced at once. From 400 to 600 ovens will be built capable of turning out 1,000 tons of coke per day. This coal cokes with remarkable facility, and the deposit is practically inexhaustible. Machinery is now being put up for bringing the coal to the surface, which will be done through a shaft from 200 to 300 feet deep. The company have purchased the mineral rights to about 8,000 acres of land, and have purchased about 700 acres in fee simple for the erection of the developing works.—*Coal Trade Journal.*

[Official Report.—Continued from page 107.]

Tenth Annual Meeting of the New England Association of Gas Engineers.

Held at Boston, Feb. 18th, 1880.

The President appointed Messrs. Dwight, Nettleton, Durfee, Yorke, and Wood a committee on the nomination of officers of the Association for the ensuing year, and the Committee retired.

Mr. Harbison—While the Committee are considering the matter of the nomination of officers for the ensuing year, I would like to say, if it is in order, that I believe every member of the Association fully appreciates the value of the statistics that have been presented to us, and I would therefore move you, sir, that that Committee be continued, and requested to still further increase the information they have given us.

The President—Knowing the Committee as well as I do, and knowing the intelligence and zeal with which their labors have been persecuted, I believe there are other questions which could be incorporated into the statistics which would be of increased value and great benefit. I suppose the motion as made by Mr. Harbison contemplates leaving the manner in which these additional statistics shall be prepared, and the additional questions incorporated, discretionary with the Committee.

Mr. Harbison—Certainly.

The motion was then put and carried unanimously.

Mr. Armington—Does that carry the whole subject over, so that nothing more can be said upon it?

The President—The motion of Mr. Harbison simply continues the Committee with power to gather additional information. The whole subject, if it is deemed desirable, can be brought up for discussion at some future time. As we have nothing specially before us at present, the matter can probably be as profitably discussed now as at any other time.

Mr. Armington—I do not desire to say anything until the proper time comes. The copy that I now hold in my hand is the first I have seen of these statistics. I have understood that a great deal of time and labor were spent in getting this information together. You will recollect that the question came up at our meeting last year, and there was a little warm discussion about it. There was something said about its being a kind of close corporation, which was, possibly, all right enough; but if the matter comes up for discussion this year, I have something to say. I will simply repeat now, however, that this is the first time I have seen any of these statistics. Indeed, I never expected to see any of them, for the reason that I did not furnish any myself; but I should like to inquire why they are in the hands of engineers who have no interest whatever in this Association, and have not had, from the time of its organization to the present hour. I, for one, should like to know why it is that members of this Association are not able to get hold of these figures, while those who are not members enjoy the possession of them.

The President—For the benefit of some of the members of the Association who were not present at the semi-annual meeting in August last, I will read the resolution upon this subject that was then passed:

"*Resolved*, That the Committee on Statistics be directed to send circulars to each member, asking him to complete returns already made, or to make returns where not made, with the understanding that copies of the same, compiled and tabulated, are to be furnished to those managers of works only who make returns: provided that any manager not making a return may be furnished with a copy of the tabulated statistics, upon a written application for the same to the Secretary, and that a list of those so applying and furnished shall be read to the Association at the annual meeting in February."

"Moved by Mr. Cabot; seconded by Mr. Gerould; adopted unanimously."

It has been the intention of those having the matter in charge to adhere strictly to this resolution, and to carry out the expressed will of the Association upon this point, and to furnish none but those making returns with copies, with the exception of honorary members. If any engineer not directly connected with this Association, or who is not an honorary member, has been furnished with a copy of these returns, I think I can safely say that it has been done without the knowledge of the Committee or of the officers of the Association. So far as I am individually concerned, I have always maintained, and I always shall maintain, that these returns should be furnished to every member of the Association. There are circumstances connected with some of the companies that prohibit the engineer from complying with our request; but I believe that the good feeling of the members of the Association should be made to overcome all these difficulties in the way of furnishing these statistics to the general public, so to speak, of our membership. There is nothing in them that can do any harm, but on the contrary there is so much of good in them that I hope their dissemination will be made more general. Under the resolution passed by the Association the Secretary had no authority to furnish any member who had not made a return with a copy of the statistics, unless such a member asked for it.

Mr. Rollins—I would like to inquire of the Secretary whether any applications were made by those who had not made returns. Col. Armington has seen these returns in the hands of those who are not members of the Association, and I for one would like to know how they obtained them.

Mr. Neal—No such applications have been made except from those who have made returns. All the papers and documents were sent to Col. Stedman. He sent me one copy, which I have kept and have not shown to any one outside of my office—not even to a director of the company. Other copies were sent around to those who had made returns. One or two, I believe, were omitted. It does not seem possible that the returns could have miscarried, but it may, nevertheless, have been the case, from the fact that two or three who made a return have not received a copy. I can answer for myself that no one has seen or received any returns from me. Col. Stedman, as Chairman of the Committee, can give more information upon the subject than I am able to.

Col. Stedman—I will say, in the first place, that the Committee complied absolutely with the resolution passed by the Association at the summe meeting. A list of those who have received copies of the statistics will b found on the first page. I have given the names and addresses there precisely as they were put upon the envelopes containing copies of the returns. Now, from the fact that two members of the Association did not receive their copies, it would seem that two of the copies must have miscarried in some way. In regard to this distribution of the statistics, I will say that the directors directed me (though I doubted their authority under the resolution to do so) to send a copy to each of the honorary members of the Association, which I did. That may possibly explain where a stray copy may have come from. Beyond that, no copies have left my office except to those whose names and addresses you see upon the first page; and I do not see how it is possible that anyone else could have obtained a copy. The president of our company asked me if he could have a copy, and I told him he could not. I told him that it was particularly necessary that I should comply strictly with the resolution passed by the Association, and so create and deserve a confidence on the part of the members that the statistics would not be misused in any way. He saw the point and, of course, said no more about it. I repeat that there have been absolutely no copies allowed to leave my office except those to which I have already referred, and those directed to be sent by the directors.

The President—The matter was under discussion by the directors, and it was decided to furnish those distinguished engineers who had honored us by associating with us, with a copy of these statistics. We considered it no less a duty than a pleasure to do so, and we thought that the Association would sustain the directors in the action they took. I corresponded with Col. Stedman in regard to the matter, and he took the same view that I did—that the resolution passed by the Association prohibited any copies being sent out save to those who had made returns. At a meeting of the Board of Directors, in January, the matter was brought up and discussed very fully, and that action was approved. The executive affairs of the Association are intrusted to the President and Board of Directors, and I fail to agree with my friend, Col. Stedman, that we exceeded our prerogative, which is the management of the interval affairs of the Association. If any member has the least criticism to make in regard to that action, I can assure him that my skin is very tough, and I am perfectly willing to accept my share of any criticism in that connection. If I were placed in the same position again, acting for the Association, in full view of all that has passed, and with full knowledge of all that has been said, I should pursue the same course.

Mr. Neal—At a meeting of the Board of Directors, held at Young's Hotel, January 9, among other business is the following: "Voted, that a copy of the table of statistics for the year 1878 be sent to each honorary member." And that was done.

Major Dresser—I think Col. Steadman's explanation is entirely satisfactory, and it does not seem to me to be necessary to say anything more upon that point. For myself, I have found it impossible to get hold of a copy, or to get a sight of one. These returns contain, as I understand, some very valuable and interesting information, and I think they should be published in the Journal. (Laughter.)

Mr. Gerould—I think, in justice to the Committe on Statistics, that Col. Armington should state in whose hands he has seen these returns.

Mr. Armington—The word "justice" appears in Mr. Gerould's remarks, but I cannot exactly see how it applies to what he wants to know from me. The idea about it is just as we talked over the matter at our annual meeting last year. You may take every precaution in regard to these matters, but there are always certain leaky vessels. That is one respect in which small societies have an advantage. The truth is that in small societies, where each member knows all the others, a member knows that what he may say

will go no further; but in a large society, where a member has not the advantage of a personal acquaintance with all the others, there are apt to be a great many leaks, and this matter seems to bear out the truth of what I say. I know that a copy of these returns is in the hands of a gentleman who is not in any way connected with this Association. I never saw one of these returns until I saw it here to-day, and, this gentleman, though not a member, could tell me all about it. I would not, under any circumstances, add a figure to these returns. There are many reasons why it would not be well for me to do so, and the fact that these returns have got into the hands of those who should not have them, confirms me in my position.

The President—I believe it is almost impossible, in an association as large as this, to keep anything like statistics entirely private. They will always leak out in some way, as they seem to have done on this occasion.

Mr. Gerould—If any member of this Association has let these statistics go out of his hands into those of an outside party, I think we ought to know it, and that he should be dismissed from the Association.

The President—In justice to the Committee, I will say that I do not believe a single member of the Association thinks for a moment that they knowingly allowed a single copy of these returns to go into the hands of those who were not entitled to them.

Mr. Neal—They have not done so.

ELECTION OF OFFICERS.

The Committee on Nominations of Officers presented the following report:

The Committee appointed to present a list of candidates for officers of the Association for the ensuing year, would respectfully recommend the following:

President—William A. Stedman, of Newport, R. I.
Vice Presidents—L. P. Gerould, Chas. F. Spaulding.
Directors—John P. Harbison, John Andrew, J. H. Rollins, Charles F. Warren, Malcolm S. Greenough.
Secretary and Treasurer—George B. Neal.

Mr. Stedman—Mr. Dwight has a letter in his possession which I desire him to read.

Mr. Dwight—I could see no reason, after reading that letter, why you should not be nominated.

The President—There is no reason in it. It lacks a reason. The Nominating Committee have decided that there is no logic in it, (laughter), and we will now proceed to take action upon the report.

On motion, the report was accepted.

The President appointed Mr. Dwight a committee to cast a ballot on behalf of the Association, which was done, and the gentlemen named were declared unanimously elected as officers of the Association for the ensuing year.

Mr. Greenough and Mr. Cabot were appointed a committee to escort the newly-elected President to the Chair.

The President—It is with pleasure that I welcome you to the office of President of the New England Association of Gas Engineers. That Association recognizes no sectional distinctions, and it is an additional pleasure to me, sir, coming as you do from my own State, and being a warm personal friend for many years, to welcome you as my successor. I can assure you that if the members of this Association extend to you, as I know they will, the same kindly courtesy that they have ever extended to me, the duties of your office will not be onerous, but the pleasure of your connection with the Association will be greatly enhanced. (Applause.)

The President-elect—I thank you, sir, most heartily for your kind words, and also the members of the Association for their very flattering preference. When I wrote that note to Mr. Dwight I did not believe that, individually or collectively, the members of this Association could induce me to alter my decission; but argument and persuasion have led me to reconsider so far as to "accept the situation." (Applause.) When I wrote the note I did not allude to any reasons that were not of great weight with me. I did not decline the position solely because Mr. Stiness and myself were from the same State, although that, I confess, had some weight in my mind, but there were reasons of a private nature, which I could not very well make public, but which were of sufficient weight with me to decide my action. I assure you, gentlemen, that I feel highly complimented by your action. I accept the position with the heartiest thanks for your preference, and I shall discharge its duties to the best of my ability, and ask in advance your kind indulgence for any errors that I may commit. (Applause.)

Mr. Neal—Having disposed of the general business of the Association, the next thing in order is the reading of papers. It is now, however, so near the hour fixed by the programme for lunch and social conversation, that it would perhaps be well to defer the reading of papers until after our recess. As there are yet a few minutes left before the hour of adjournment, I would suggest that a committee of three be appointed to take into consideration the place for our next semi-annual meeting, and report upon our reassembling this afternoon.

Carried.

Mr. Neal—Since the motion was made it has been suggested to me that it would be better to leave the question as to the place of our next semi-annual meeting to the Directors. I would therefore move a reconsideration of my previous motion.

The motion was reconsidered.

Mr. Neal—I now move that the matter of fixing upon a time and place of the next annual meeting of the Association be left to the Board of Directors.

Carried.

On motion of Mr. Spaulding, a most hearty vote of thanks was tendered to the retiring President for the services rendered by him during the past three years.

The Association then adjourned until 1:30 P.M.

AFTERNOON SESSION.

The Association was called to order at 1.30 P.M.

The President—The next business in order is the reading of papers. In my private capacity I prepared a paper on the "Value of Statistics," and perhaps I had better begin by reading that. If there is any parliamentary necessity for calling upon any one to read it, instead of myself, I will ask some member to do so; but I do not think there is. There is an old saying—"Great minds run in the same channel." The fact that we both live on Narragansett Bay may account for the fact that some of the ideas presented by me were also attended to by the President in his address this morning; but I assure you there was no collusion between us. The fact that some of the passages are nearly identical is simply one of the possibilities of concurrent thought.

Mr. Stiness—I will state that I had the privilege of reading Col. Stedman's paper before I delivered my address. (Laughter.)

Mr. Stedman then read his paper as follows:

THE VALUE OF THE STATISTICS.

Some reminiscences of the period just prior to the formation of our Association may be called up as a preface to this paper. It seems scarcely credible, in view of our present extended acquaintance among those engaged in the business of producing illuminating gas, that we should have once maintained a comparative isolation in the conduct of our business, or that we should have so long failed to realize the immense benefit which all can see has been the outgrowth of our Association. On the rather rare occasions when we visited each other, we felt as delicate and cautious about making inquiries as if we had been prying into private family matters, and the uneasy consciousness of possibly venturing so far as to be considered impertinent or intrusive barred the free interchange of experience. Then, again, the lack of frequently meeting, and the fact of superficial acquaintance among members of the profession, promoted a feeling of exclusiveness, and allowed sometimes a hardly-admitted sense of jealousy lest some one whom we knew but little of, and cared less for, might avail himself of our experience.

These sentiments were natural enough among strangers or slight acquaintances, and the founders of this pioneer society, seeing the disadvantages resulting from a lack of cooperation, of comparison of results, and of the stimulus of a generous rivalry, called together those widely separated, but working in a common cause, and organized the New England Association of Gas Engineers.

The result of that organization has been to realize, and more than realize, the benefits anticipated by its promoters. The regular meetings of the Association are few, but, by bringing together a large number of workers, whose experiences are wrought out under a great variety of conditions, the occasion is afforded for the full exchange of opinion, the correction of erroneous conclusions, and for the implanting—sometimes in the most casual way—of richly fruitful suggestions. One man's knowledge accumulates slowly and painfully, and he knows how *not* to do through many a mortifying failure. And how many of us can recall a confident setting out over an apparent highway to achievement, and the disheartening discovery of a fence across our path that turned us back. How much of effort and chagrin might have been saved had we met sooner the weary brothers who had already explored the blind alley, and whose generous shout of "No thoroughfare!" would have saved our attempt.

To my mind, one of the signal benefits of the Association has been the promotion of that intimacy of acquaintance out of which has sprung the unity and fraternity which can make the aggregated experience of all the property of each. The cordial relations which intimacy engenders survive the dispersion of the meeting, and in the intervals between our conventions,

our casual encounters or visits to each other's works, are occasions to renew and to stimulate our mutual interest.

Looking back upon the ten years since our organization, and enumerating the advantages gained and the gratifying progress in the methods and results of our business, which have come in a large measure from our Association and its meetings, we have much to be proud of and to congratulate ourselves upon; but quite as much to regret that our meetings have not always been as remunerative as they might have been had each contributed his share of information to the common stock, and, with earnest desire for the advancement of our special industry, had given us the exact result of close investigation and accurate record of some one experiment, however simple its subject.

Theoretical deductions and chemical possibilities are instructive and often suggestive—always interesting as abstractions. But to the busy man in the daily application of his experience to the practice of his art, the recorded facts of successful work are the guides that give direction to his efforts and mark the limitations of economical results.

How can each one contribute in a more simple and direct manner to the common fund of information, than to give a yearly report of his work and under what conditions he has accomplished it. Can an equally valuable amount of information be procured by the Association for its members in any other way? The annual statistics embrace intelligence which many will remember to have sought and imperfectly obtained through much visiting and interrogation. The average of prices, the custom in regard to street lights, discrimination in favor of municipalities or large consumers; these are matters in which we conform to the general practice, and vindicate our action by appeal thereto. But beyond all this we have here the invaluable opportunity of comparing our results with the best obtained, and of knowing just where to look for the knowledge we need of the methods by which our own results are surpassed. Be it in product per pound of coal, or product per retort, or in illuminating value; in degree of purity or means of purification—in whatever direction we seek to progress, those who show the lead presumably stand ready to disclose and explain their methods. We accept with undisturbed complacency the theory that we might or ought to do better; but the recorded facts that show our results to have been practically surpassed, stimulate our ambition and arouse our efforts to do better work.

Better work means more careful and intelligent work; and he who is stimulated by the prospect of an annual demand for an exact statement in detail of his operations to keep careful and conscientious record of every department of his business, has started a system the lack of which renders the best work impossible. The habit of careful calculation and daily record of the effect of any change of material or process, and the means thus presented of comparison with previous results, offer the highest incentive to close and critical observation, and afford the solid satisfaction of exact knowledge.

Without doubt the reception of the questions by members has already resulted in an increased and extended attention to recording the details of daily work. That these results have largely inured to individual benefit is as certain as that they will largely increase the carefulness of any future statistics. Not less does the habit of exact knowledge and statement enhance the value of our conversations or debates. If we know a man to be careless in matters of record or calculation, we expect him to be loose in his talk, and mentally take off allowance for discount. On the other hand, we are apt to give large credence to his statements who habitually makes figures over his work, and who is known to be ready with black and white to back his assertion. Good habits have certainly been stimulated by the statistics, and we ought to keep up the stimulus.

Not only continue the statistics, but extend them. Of course, increased anvantages will result from increasing the information embodied in them. A unanimity of concurrence in response to the questions from all the companies represented in the Association is desirable, but not indispensable; though it would seem to be overcaution that prevents answers to questions of price, arrangement of works, and many details which may well be matters of common notoriety. Other questions may be considered too prying, and their answers involving too much publicity. But we ought to have confidence in each other that our choice secrets will be locked with masonic fidelity in the breasts of our brotherhood, in the first place; and in the second place, reflect that but few facts embodied in our statistics could remain secrets to anyone determined to obtain them, even if they remained outside the tables. And then the law makers are pounding on the ice of our reserve, and once it is broken we shall have to show our hand pretty freely at the demand of the general public. We maintain our reserve now to the detriment of our own Society.

Promptness of reply would enhance the value of the statistics. By the first of February all replies could be in, and, granting that the major part of them were in sooner than that, the tabulation could be completed and printed in time for distribution and discussion at the annual meeting. What we want is the latest information, and not what were facts a year or two ago. The latest practice, not the methods of previous years. In these times of rapid advance and change, year-old prices of gas or materials have lost interest. We want the newest and most progressed results, the stimulus of the highest attained mark.

Response of some kind in acknowledgement of the receipt of authorized documents sent out by the Association in quest of information, would seem to be easy enough; and yet the completion of the tables has been long delayed by the impossibility of obtaining any recognition whatever from members in reply to the simple request that they should send in their answers or say that they decline to do so. The hope that, after due procrastination, the missing replies which should complete the list would come along, proved a hope deferred, and caused the final closing of the columns to be also deferred. A postal card from each delinquent, promptly sent before the note calling for it had been laid out of the hand which received it, would have saved vexatious delay. One can but wonder, considering the little cost of courtesy in correspondence, that there should be such a scarcity of the article.

With such tables as we might have after a year or two of hearty accord in pushing them toward perfection, what a compendium of facts, embracing all the points of the latest and best practice in our industry, would be presented! If there be those who seem not to need, or be benefited by, such information, the deductions are matters of interest and curiosity. We might afford to contribute to the general fund of knowledge, even if we get no dividend from the fund. And then it may well be doubted whether the tables do not furnish some positive benefit to every one in the business who receives hem—either in some provoking statement of apparently unattainable result, some suggested improvement, or in value as a measure of our own average of success. The questions may suggest to many the proper heads of accounts, and the desirability of bringing all charges in accurate division of classes to their respective departments. And the need of accepted units of measurement will be aggravated by close comparison of results, and we shall be stimulated to find and adopt them.

The evils which are thought possible as the result of committing ourselves too much to record, are mostly imaginary; and if the feeling which prompts our fears is the lingering of the old exclusiveness and desire for secrecy which accompanied slim results and high prices, it need no longer exist. The fact that the interests of produces and consumer are identical is now accepted, and the necessity to give the best value for a fair return is recognized. We have nothing to fear if in doing our work faithfully some one should find us out.

Mr. Stiness—There is one matter that Col. Stedman touched upon that I did not refer to, of course, in my address. I stated that the returns should be published early in the year, and that I most earnestly hoped that during the ensuing year the Committee on Statistics would be able to prepare a table for 1880, and have it printed and circulated and ready for our annual meeting in 1881. As is well stated in Col. Stedman's paper, the value of these tables depend in a great measure upon the promptness with which they are furnished to the members. There are so many points ably touched upon in the paper to which we have just listened, that I hope the paper will meet with the discussion that it deserves.

The President—The furnishing of replies is of course a voluntary matter upon the part of members, and I should like to hear what objections they have to sending replies to the questions.

Mr. Neal—Before discussion takes place on this topic, I move that a vote of thanks be tendered to Col. Stedman for his interesting and able paper.

Carried.

Mr. M. S. Greenough—The only thing which I think is to be said after the able and exhaustive paper which has been submitted is this: The reluctance felt by so many gas companies to putting their figures into the hands of anybody who can deduce from them results which are unfavorable, is very natural. If we can succeed in getting some sort of legislation that will give us more security from opposition than we at present enjoy, I think the objection which many companies now have to putting their figures before the public will disappear. But unless something of that sort is done, and while so many companies are threatened with competition to the extent that they are now, I greatly fear that we cannot get additional figures, and that some that have already been given will be withdrawn.

Mr. Stiness—I take issue with my friend Mr. Greenough. Perhaps it may be through ignorance. Never having been favored with any opposition company in our vicinity, of course we have not enjoyed that luxury, and don't know what the privilege is. I hold to this (though I may be mistaken, and if I am I want to be corrected), that by the publication of a table like this we find that a certain amount of gas is produced per ton of coal. There is a certain value in candle feet to that ton of coal. It costs a certain amount of money to produce it. In the advancement which will undoubtedly be made, judging from the advancement which has been

made, these figures will increase or show better results; and, therefore, when a man comes along and says, "I can put water gas into your holders for 65 cents per thousand," I say to him, you must show better figures than that, and must put gas into our holders for a less price than that, and that drives him away. He does not want to enter into competition with a company that he knows is putting gas into its holders cheaper than his process can do it. That is my opinion in regard to the publication of these statistics. We cannot tie them up by a vote. We may think, in our ignorance, that we are guarding them ever so closely; but there are those who are governed by a strong motive, and they will procure these figures in some way. Now, when a man examines these tables, and sees results ranging far beyond what is generally supposed are obtained from a ton of coal, he will see that he cannot compete with the present companies. Therefore, it seems to me, in that aspect of the case, that the publication of these returns will deter many from entering into competition with coal gas. Many persons come into places for the purpose of blackmail, and it makes no difference whether your returns are published or are kept perfectly quiet, the same principle governs. Perhaps gentlemen who have been favored with opposition companies can give us more light upon this question than I can, but that is the feeling I entertain in regard to the matter, believing, as I do, that when these men find that we can produce illuminating gas at certain figures so far below what they can do by their processes, they will be deterred from entering into competition with coal gas companies.

Mr. Coggshall—As an illustration of what has already been said. I will state that about three or four weeks ago an agent for the Lowe process called on me to see if I didn't want to introduce that process, and saying that it would enable me to sell gas at a less price than I was selling it. He told me what he could put it into the holder for, and gave me his prices. I took down my books for last year, and showed him my consumption, the amount of coal used, and the cost of putting the gas in the holders, and he said it was not of any use for me to buy the Lowe process. (Laughter).

Mr. Neal—We have a paper by Mr. Cabot upon the use of "Tar as Fuel" under the benches of his works, which, I am sure, we shall all be very glad to hear. It was submitted to the Directors last evening.

Mr. Cabot—If I had been aware that our distinguished friend from New Jersey would be present to-day, I might have refrained from submitting this paper. As it is, I wish you all to bear in mind that these are facts obtained from two consecutive years of consumption of coal tar, as mentioned in the paper, one year in connection with coke. What might be beneficial to us might not, of course, be beneficial in larger works.

Mr. Cabot then read his paper as follows:

VALUE OF TAR AS FUEL.

It is the desire of all managers of gas works to obtain the best possible results, and to be able to sell gas at the lowest price, leaving a fair margin for profit. Another has said—

"The ideal we descry at a distance becomes itself an inspiration to make the actual close at hand."

This, I trust, may be so with all of us.

Our worthy President, who is always on the alert, and desirous of making our meetings pleasant, and who is never happier, I think, than when we can have a pleasant discussion, has inveigled me into giving some details of the value of "Coal Tar as Fuel," in the hope, I presume, that some discussion on the subject will ensue.

I do not think I am calling the attention of any of you to anything new; nor do I propose to put before you any new discovery. Many of you have a greater knowledge of the subject of the manufacture of gas than I claim.

Quite an item to be deducted in making up the cost of gas is the amount obtained for the residuals; at the present those that give the largest returns are coke and coal tar, though I hope the day is not far distant when we may add to this list ammoniacal water.

At the works under my charge, during the past eighteen months, we have used tar as fuel successfully and profitably. During the general stagnation of business some two years since, there was no market for tar at a price that would pay to transport it; and I turned my attention to using it as fuel under a part of our retorts. After various experiments I became satisfied of its value for this purpose, provided we had a market for coke, which, fortunately, we had.

I give the result of two years' work—1877 and 1879—the coals carbonized each year being from the same mines, and weighing the last year only ten tons more than in the first. The first year (1877) we used only coke for fuel; the last year (1879) we used coke and all the tar made.

The coke used during 1877 was equal to 1·75 bush. per M feet of gas made.
" " 1879 " 1·16 " " "

The difference in fuel required this last year was made up by the tar burned.

The saving in coke was 30,326 bushels, which, if sold at eight cents per bushel, would give the following result:

30,326 bushels at 8 cents	$2426 08
Deduct additional fuel used under boilers for steam	120 36
	$2305 72

If we estimate the amount of tar produced at ten gallons per ton of coal, we had for (sale, or) use, 46,400 gallons, or 1,003 barrels, of 45 gallons each, at $2.30 equal $2308 60—the value of the coke.

This gives the value of tar, *in the tanks*, at the following prices for coke, to be—

Coke at 8 cents per bush., or $2.88 per chal. = Tar at $2.30 per bbl.
" 9 " " 3.25 " = " 2.60 "
" 10 " " 3.60 " = " 3.02 "

or, per ton of coal carbonized.

Coke at 8 cents per bush. = Tar at 49·75 cents per ton of coal.
" 9 " " = " 56·23 " "
" 10 " " = " 62·76 " "

I will add that our arrangement for using tar is such that we have no handling of it, feeding it directly to the burners as made.

LAWRENCE, MASS., Feb., 1880.

Mr. Harbison—I would like to inquire what kind of a burner Mr. Cabot uses in burning tar?

Mr. Cabot—We are using a burner very similar to that used by most companies, something similar to the Newark burner. It is one that we got up for ourselves after some experience. It is very similar to Mr. Yorke's burner.

Mr. Harbison—Used in connection with steam?

Mr. Cabot—Yes; with a small body of coke. The coke we have used is embodied in the general quantity of coke we have used during the year.

Mr. Harbison—How much coke is used per bench during twenty-four hours?

Mr. Cabot—I cannot tell from memory. Just enough to form a bed; that is all.

Mr. Harbison—What is the effect of the heats?

Mr. Cabot—Some of our benches have been running for a year—perhaps fifteen months. It has generally been supposed that the heats are detrimental to the benches and the arches, but, so far as we can discover, there have been no evil effects.

Mr. Stiness—Mr. Slater has burned tar, I believe. He is present, and he can perhaps give us some information in regard to it.

Mr. Slater—We used tar some years ago. We commenced using it by putting in one of Mr. Vanderpool's burners. We tried it for a few weeks, and then put in about half a dozen more. Since that time we have been using three or four burners, and, in a general way, we produce from 25 to 30 per cent. better results than we did in using coke.

The President—Results in what direction?

Mr. Slater—In the production of gas and in coal carbonized. We carbonize very much more material, and get better results.

The President—The capacity of the retorts for carbonized production is increased?

Mr. Slater—Yes. Some months we have manufactured from 9000 to 9400 or 9500 feet per retort of 14x29. We have gone up as high as 1100 feet in 24 hours by using tar fires alone. In a general way our results are much better in using tar fires, not taking into account the wear and tear of the benches, which is, perhaps, somewhat greater than in using coke.

Mr. Harbison—For what length of time have the charges been run?

Mr. Slater—Four hours.

Mr. Neal—The question which naturally arises in calculating the economy of the use of tar as compared with the use of coke for fuel, is this: For which does your company find the readiest sale, the tar or the coke? If you can get a better price for your tar, it seems to me it is economy to use coke for fuel. On the other hand, if your coke finds a ready sale, and your tar does not, it seems to me that it is economy to use tar as fuel. In our works we have no difficulty in selling all the coke we can make, and more besides; and we are obliged to draw upon the Boston Gas Company for supplies, and then we do not always get what we require. At the same time, we get from $1.25 to $1.50 per barrel for our tar, but I have never seen my way clear to use it. It seems to me, judging from the experience of others, that it is more economical for me to use coke. Mr. Cabot gives us some figures which are quite remarkable, and evidently it is to the benefit of his company to use tar. Mr. Vanderpool uses tar, and he can undoubtedly give us some interesting and valuable information upon the subject.

Mr. Vanderpool—We have been using tar for five or six years. It seems to me that this matter depends entirely upon the comparative value of coke and tar. I think the question is: What is a ton of coke worth, and what is a ton of tar worth, either for heating purposes or for sale? I have found

that a ton of tar, for fuel, is equal to two tons of coke, and that determines, very nearly, the value of tar for fuel. Another point is this: There is, in the use of tar, a decided economy in the labor account, on account of the increased yield per bench, as mentioned by Mr. Slater. I find that the results show an increase of more than 10 per ct. in that respect. I estimate the tar at 48 cents per ton carbonized, and coke at 8 cents per bushel. If we made tar enough to run all of our benches, there would be a saving of labor of about 3 cents per 1000 cubic feet of gas; but of course we don't produce more than one-third of the amount of tar required to run all of our benches, and we put down the saving in this respect to about 1 cent. There is no question in my mind but that, at the prices we are at present offered for tar and for coke, it is better to burn the tar.

Mr. Neal—What price do you get for tar?

Mr. Vanderpool—We do not get anything for it, as we burn it. We had an offer of thirty-five cents per ton of coal carbonized, or for 10 or 12 gallons of tar.

Mr. Stiness—What is your quantity of tar per ton on the general average?

Mr. Vanderpool—I think about 12 gallons per ton; but there is a great saving of labor, the furnace stoking being nominal.

Mr. Neal—You spoke about an increase of 10 per cent., but I do not exactly understand what you meant.

Mr. Vanderpool—I mean that a bench of retorts run with tar will yield not less than 10 per cent. more gas, on an average, than a bench run with coke, and increase the product per man per day 40 per cent.

Mr. Neal—Have you more than one chimney?

Mr. Vanderpool—We have distinct flues for each bench.

Mr. Neal—All in the inside of the retort house?

Mr. Vanderpool—Yes, sir.

Mr. Neal—Have you any difficulty with smoke?

Mr. Vanderpool—We have smoke sometimes, but that is on account of carelessness. There is no reason why, with proper care, and with proper checks and valves, there should be any smoke.

Mr. Harbison—I would like to inquire whether you do not find that the retorts burn out faster than when coke is used.

Mr. Vanderpool—I will answer that question by saying that it depends a great deal upon the setting of the retorts. I started four benches under tar fires, and kept them going under tar fires until they were used up, and my recollection is that those benches made something over 5,000,000 to the retort before they were used up. Of course, they were subjected to an increased heat all the time; but that was the result.

Mr. Harbison—What kind of settings?

Mr. Vanderpool—I do not know that I can describe them, particularly, in words. They were well put up and well supported.

Mr. Slater—In reference to the comparative values of coke and tar, I suppose it is the case with most of us, except, perhaps, the smaller companies, that we have a certain quantity of tar that we have not been able to dispose of. We have sold some, but we have a large quantity that we have not been able to dispose of at any price.

Mr. Harbison—What is your storage room for tar?

Mr. Slater—We have storage room for 4000 or 5000 barrels. We felt rather forced to use tar. We commenced on a small scale, and we have used nearly all the tar we have made. We have sold a small quantity in the summer, but we burn nearly all we make, and we are very well satisfied with it indeed.

Mr. Vanderpool—There is one other point in reference to durability. I do not think, when the retorts are properly set, that there would be any trouble on account of their burning out more rapidly with tar, in proportion to gas made, than with coke fires.

The President—Do you protect the lower angles of your retorts?

Mr. Vanderpool—No, sir, we do not. Three or four years ago, when the price of dead oil was very low, for four or five months we used nothing but tar and dead oil. We then sold from 34 to 35 bushels of coke to the ton all round. Of course we used some coke for our steam for injecting the tar, and some coke under the benches—I think about 8 or 9 bushels per ton of coal carbonized.

Mr. Neal—Mr. Yorke has had some experience in burning tar, and perhaps he can give us some figures.

Mr. Yorke—I have nothing in the way of figures with me. I can only state that I have been burning tar for a year, and my observations are that 48 bushels of coke per ton are equal to about 70 gallons of tar, in the carbonizing process. Those are about the only figures I can give at the present time.

Mr. Neal—Do you use steam?

Mr. Yorke—Yes.

Mr. Vanderpool—Two gallons of tar are more than equal to a bushel of coke.

Mr Yorke—Yes; formerly it took about 48 bushels of coke to fire our benches, but 70 gallons of tar will heat them better than 48 bushels of coke. We use a very little breeze and coke in the furnace. I put in my tar burners about a year ago, and since that time I have been burning about two-thirds of tar burners to one-third of coke benches. The amount of tar that is made from the coal will support about two-thirds of my benches.

Mr. Neal—How about the durability of your furnaces and retorts?

Mr. Yorke—I can hardly answer that question satisfactorily; but I have a bench in action with tar on which a tar burner was placed a year ago this February, and I think that bench will run three or four months longer. The usual lifetime of my benches is 15 or 16 months. I do not believe that tar is any harder on benches, according to the amount of gas produced to a bench, than coke is.

Mr. Neal—Mr. Vanderpool said that the tar produced in his works would supply one-third of the fuel required. You say two-thirds?

Mr. Yorke—Yes. I have been running ever since last June with two-thirds tar; and for the past two months I have been running four benches with tar and one with coke. I have five benches in action now, four running with tar and one with coke, and my tar well is pretty nearly full now.

Mr. Vanderpool—When I spoke of one-third, I meant running benches entirely with tar. I understand Mr. Yorke to say that he uses a portion of tar and a portion of coke.

Mr. Yorke—I say that we simply use enough coke to keep the furnace in the right state.

Mr. Vanderpool—Do you know how much that is?

Mr. Yorke—Yes; about two bushels of breeze and coke in the 24 hours. We clinker every 48 hours.

Mr. Neal—Do you take into account the expense of the same?

Mr. Yorke—No; it is scarcely perceptible. Of course, there is some expense, but it is very small and not enough to affect the result. I have a steam pipe which runs over the chimneys, or the flues of the chimney, in my retort house. The steam running over these chimneys has a tendency to be superheated before it reaches the benches.

My opinion is that the tar produced will run at least two-thirds of the benches in action. I have always found that 48 bushels of coke were required per 24 hours for each bench. My benches are fives, and for the past few months have produced, on an average, about 32,000 feet per day, almost 7,000 feet to the retort.

Mr. Neal—Mr. Gerould has attained some remarkable results at his works in his yield, and I would like to inquire of him if he uses tar or coke?

Mr. Gerould—Only coke.

The President—Will you favor us with your results from high heats.

Mr. Gerould—I have no data with me. As near as I can recollect it was, upon one occasion, 182 feet less than 11,000 feet per retort, for six days, from coke alone.

The President—How much coke did you use?

Mr. Gerould—As near as I recollect now, we used 60 per cent. of coke.

Mr. Harbison—What is the size of your retorts?

Mr. Gerould—Two of them are 12x20 and one 14x26. That was merely a trial as to what I could do on a bench of three. I would not undertake to keep that up for any length of time. In regard to the coke question, I will say that, to produce five and one-half feet to the pound, I find I am obliged to use from seventy to seventy-five gallons of tar per day, and from twelve to fifteen bushels of coke to the bench of three retorts.

Mr. Stiness—I met a gentleman a while ago, down in the lobby, who is slightly interested in the gas business. He said that he could convince any man that it was cheaper to sell tar than it was to burn it. He may be able to convince some, but I think he will have a hard task to convince a great many of the members present. We have been burdened with coke for the past few months. I have tried tar and have increased the yield per retort more than 10 per cent. There is no question in my mind but that excellent results can be obtained from the use of tar as fuel; but I do not quite see my way clear to use it when I get $2 per barrel for my tar and 4 cents per bushel for my coke.

Mr. Yorke—My observation is this—that we can sell all of our surplus coke at 7 cents a bushel, which is equivalent to tar at $2 a barrel. I have figured it up very closely. We sell our coke at eight cents per bushel at the works in small quantities, but we have sold in large quantities lately at seven cents per bushel, which is just about equal to two dollars a barrel for tar. We sell no tar for less than that; at least for the past year we have sold 150 barrels at $2.00 a barrel, and as long as we get seven cents a bushel for our coke, I do not think there is any question about the economy of using tar. So far as the extra strain upon the retorts is concerned, I do not think it amounts to anything. I think that coke will burn out retorts as quickly as tar will. Formerly, when we used nothing but coke, I was very well satisfied to make an average of 30,000 feet to the bench, for 15 months, and we can easily do that now. Our tar burner is a very simple one. There is no patent on it. It is a very simply constructed affair, and works well. I

put one in about June last, and it has remained there since, and has worked very satisfactorily. The first one we put in lasted about four months; but I found the trouble was that the man who attended to it had used the tuyer iron in connection with it in an improper manner. Since that time we have had no trouble whatever.

Mr. Rollins—I should like to inquire of the President what has been his experience in burning tar.

The President—We have very little coke because we have always sold it at four cents per bushel in order to keep the yard free. At that price for coke it hardly seems worth while to burn tar, for which we can get $1.50 per barrel. That is about the figure we realize for it, although we have now put the price up to two dollars per barrel, and I think we are safe in doing so. I believe if we all put our tar up to that price we could get it.

In our experience, the burning of tar produced no unsatisfactory results, other than burning out the retorts. It seemed to have an effect upon the inner angle of the middle retort. When the flame burned up pretty freely, we found there was constantly a tendency to produce that result, and there was a gradual enlargement so as to make it necessary to let the bench down and patch it up. But there are those who have rather misquoted me, and I presume they have spoken in rather a derogatory manner as to my experience in burning tar. I have not intended to convey any idea as to the value or availability of tar as fuel. I simply gave some figures to a coal man, derived from our experience in burning tar, and showing whether we were justified in selling at a certain price; and I suppose that what may have been said may be taken with some little allowance or discount.

Mr. Yorke—The effects upon the bench which you have mentioned might have been the same with either tar or coke. A man might start one bench with tar and another bench with coke, and the coke bench might give out first, or the tar bench might give out first. I have four tar benches at the present time and one of coke, and the tar benches are in just as good preservation to-day as the coke bench is; but it might have happened that one of the tar benches gave out first. There is no doubt in my mind whatever but that tar keeps up the heats much higher, and produces much better results than coke. That is my experience, at least.

The President—I will say that, in reference to burning tar under retorts, I think the opportunities for exact investigation are peculiarly good in small works. I think it is sometimes the case that they can teach their larger brothers something that they cannot very well ascertain for themselves. They cannot always find out the exact details of daily work so closely and so exactly as small works are able to do. There is an opportunity for ascertaining exact results from day to day. You can tell how many bushels of coke you burn in your retorts, and how many bushels of coke you have left, and exactly how many gallons of tar you use. I measured in one of our benches the coke we used every day, and I had a tank made with a strong counterbalance running on a gauge at the outer end, which indicated how many gallons of tar went out of the tank. By that means we kept a check on the amount of tar burned. Although we endeavored to burn as much as possible, it didn't produce a clear flame. We kept down the amount of coke, however, very low. I think our experience was that we burned in the bench from four to five bushels a day as a base for tar fires, and something between 70 and 80 gallons of tar, and our yield per bench was about 30,000, which was all we required at that time, and we sold 31 or 32 bushels of coke per ton. I wish I had my figures with me. I wish we all made our memoranda on something that was portable, and put them in our pockets, so that when we came here we would be able to make exact statements instead of statements from memory alone; and I think such a plan would enhance the interest of our meetings very much, because then we would be speaking from the record which we made at the time our investigations were made and our results ascertained. I hope each one of us, during the ensuing year, will make and keep his memoranda in such shape that he will be able to bring it with him next year, so that when any question arises he will be able to speak from the exact figures.

Mr. Gerould—Do I understand you to say that you sold 34 bushels of coke per ton besides what you used?

The President—We sold at that time, I think, from 31 to 33 bushels—sometimes 33, sometimes 31. It seems to me that there is a great necessity for some exact unit of measurement, and that that necessity is clearly shown by the variety of results which are obtained. Some gentlemen get 42, some 36, some 33, some 32, etc. The parties who make the bushels do not seem to have any exact standard of measurement as to height and diameter. Sometimes we get baskets that alter the results considerably. I think we sold from 31 to 33 bushels on different days.

Mr. Gerould—The subject of the measurement of a bushel of coke bothers me considerably; and I should like to know exactly what a bushel of coke means.

Major Dresser—Upon the subject of the size of the measures used in measuring coke, perhaps it will not be uninteresting to give you a few figures which are the result of exact calculation and experiment. It was asserted by some gentlemen that they got 42 bushels of coke from a ton of ordinary Westmoreland coal. Others who had had a long experience claimed that they could never get that amount; and two or three of us went into a series of experiments to find out what could be obtained, and we were rather disappointed in finding that we did not get 42 bushels out of a ton of Westmoreland coal. That bothered us, and we concluded the trouble must be with the measurement; and we started a new set of experiments, where we *weighed* the *coke* that was made from the coal, and we found the weight did not correspond with the bushels. Now, there was no mistake about the weight, so we investigated the bushels, and we found that the mistake was there.

A three bushel measure had been used to measure this coke. It was an ordinary struck measure, and it had been heaped, and, of course, every time it was heaped that added just so much. Then I went to work to figure out this problem, and I hope, if the result is satisfactory, it will be adopted here.

If you take a cylinder eight inches deep and 18½ inches wide, it gives you a struck standard bushel. If you add to that a true cone, six inches high, with a base of 19½ inches, allowing half an inch for the rim of the measure, that makes a standard heaped bushel. That is the regular Winchester bushel. Then if you want a three bushel or a five bushel measure, for convenience, it is very easy to make.

For instance, a cylinder which is, on the inside, 23½ inches in diameter, and 19½ inches high, inside measurement, will hold three heaped bushels. When you use that as a struck or water measure, the inside circumference will be 72 21-22 inches. It is a very easy thing to make.

Now, the moment we adopted the true measurement for a bushel, then our figures conformed to those made by Mr. Vanderpool, and we obtained the 42 bushels. Not only that, but we took the record of experiments which had been made for the past ten or fifteen years in a large gas works in New York, and figured up the amount of coke that was obtained in testing different kinds of coal, and we found that the average was just a trifle over 41 bushels.

Mr. Yorke—I suppose with most of us 2150 inches is considered a standard bushel, or struck bushel, and 2650 inches is large measure. In regard to the production of coke in bushels I will say that I have two different kinds of coal; and I find that New Castle coal will yield 42 bushels, Penn coal will yield about 40, Despard coal about 38, Kanawha coal, although I think it is a tip-top coal, will only yield, I am sorry to say, about 32 bushels. I do not mention this as bearing against Kanawha coal, because although it yields less coke than some of the other coals I have named, yet I think it preferable to many of them.

Mr. Vanderpool—What do you find the weight of the coke to be?

Mr. Yorke—Kanawha is 1460, I think. None of them exceed 1480 per ton of coal carbonized. Newcastle was two bushels ahead of any of the others.

Mr. Vanderpool—How much was the weight of that coke?

Mr. Yorke—I forget the exact figures; from 1450 to 1460—I believe.

Mr. Gerould—I should like to know how much a bushel of coke is. The state of Massachusetts has a statute law defining in exact figures the dimensions of a coke basket; and I have had my baskets made by the standard established by that statute. It says that a basket made according to those figures should contain two bushels.

The President—Please give us your results, using that basket.

Mr. Gerould—I could not tell you now what the exact figures are. I could not tell now the number of cubic inches these baskets contained; but the statute is easily found. I cannot now remember all the results of my experiments; but I got, I believe, 45 bushels from a ton of Penn coal. The lowest, I think, was 41 bushels. I see Mr. Cabot got 49 bushels out of a ton, and I would like to know what his measurement was.

Mr. Cabot—I can answer that question. You remember that a few months ago the gas companies of New England made a series of experiments, and among the questions asked was this one. My experiments were made in this way: I had a box made containing exactly 3 bushels. It was sealed by the State sealer of the State of Massachusetts, and I measured the coke in that box with the results I have given, viz., 49 bushels per ton. They thought my result was very large, and they wanted to know if I did not wish to change my figures. I made another experiment, and wrote that I did not want to change my figures. The box that I used was examined and branded by the State Inspector, and was sealed. That is what went by.

Mr. Gerould—Mr. Cabot is the one who got the largest results from a ton of coal. I see by these returns that Mr. Neal gets 26 bushels, and I should like to hear from him,

Mr. Neal—It says 26 bushels, but it is a mistake, of course. It must be a slip of the pen. The only way I can account for it is that the figures must have been transposed, and that it should have been 62. (Laughter.) It is very evident that it is a mistake, but how it occurred I am unable to tell. I made an error once through inadvertance, but I did not hear the last of

for about a year. I find, however, by another return, that the number of street lights in the city of Newton is simply enormous. Perhaps Mr. Gerould can explain that.

Mr. Gerould—I never saw the proof of that return. I find by the returns of 21 companies that the average is about 32 bushels of coke per ton of coal.

Mr. Stiness—If there is any doubt about our measurements, we could adopt this improved measurement all around. Whether our customers would like it so well I am not prepared to say; but I think it could be adopted with very little trouble.

Mr. Neal—By these returns, which are "strictly private," we find that some people make errors as well as others. The number of street lights in Boston proper is here set down as 4178, and the city of Newton, 6825.

The President—I will say, by way of explanation of this error, that after the tables were set up the printer gave us a proof. That was corrected. He then sent us a corrected proof, and we went over that. He sent us a third proof, which was returned to him after we had examined it, and he went on and printed the figures. Although we went over these proofs very carefully each time, one after the other, the printer concluded, on his own responsibility, to put in that extra 6000.

Mr. Coggshall—It says 26 bushels, but it weighs 57 pounds per bushel. Here is another that returns 42 and it weighs 31 pounds. That may probably explain Mr. Neal's bushels.

The President—I ask the pardon of the Association for again referring to the paper I read where I urge the comparison of results and the necessity of a unit of measurement. It seems to me that we are all impressed with the fact that we do want some fixed standard or unit of measurement, and, knowing what we want, we ought to try to get it.

Mr. Coggshall—In looking over these figures I see that a great many of the companies get more bushels of coke than I do, and therefore I think there must be something wrong in my measurements or in theirs. I think, therefore, that in the comparison of results it would be important to know what the units of measurement were in each case.

Mr. Cabot—I am satisfied, from a series of experiments that I have been making, that we have been giving more than 36 bushels to the chaldron, and I presume that is the case with most if not all of us. That brings up *the* question whether we should adopt a uniform bushel and sell our coke *by* the bushel, or sell it by weight. Of course, the objection to selling by weight is that we all know that a certain quantity of coke will weigh more or less according to its exposure to the weather; but I, for one, am satisfied that we are selling very much more than thirty-six bushels to the chaldron.

Mr. Stiness—There is another interesting matter in connection with these returns (they are strictly private, of course), and that is the quantity of tar produced per ton of coal. Here are returns from 22 companies, and you will see, by reference to the figures, that the results vary considerably. Perhaps, in the case of some companies, they do as I do. I simply take the tar that comes from the hydraulic main, paying no attention to the tar which comes through another tank. I believe, however, that it is the policy of most gas companies to produce as little tar as possible per ton of coal. I know that I am producing much less than I have been. Of course, running with very much higher heats, I have less tar. My foreman came to me sometime in the month of January, and said, "You have got to let you heats run down; you can't continue those high heats.' I asked him why not. He replied, "Why, you wont have any tar to sell to Mr. ——— next summer." I replied to him that we were running gas works, not tar works. In making the returns it seems to me that it should be stated, as some of the members have, whether the quantity of tar produced per ton of coal is from all sources. The question presented to me was, what was the yield of the hydraulic main in 24 hours? I took no account of the tar which might run from some other tank. The manner in which I arrived at my result was by cutting the pipe that leads from the hydraulic main, and placing a gauged vessel under the pipe, letting it run 48 hours, and removing the vessel every 24 hours.

Mr. Yorke—I spoke about that same thing at the time these questions were being propounded. I suggested that the question should cover tar from all sources; but there was some diversity of opinion upon that point, and I suppose it was deemed best not to frame the question in that way.

In my infancy (as a gas man) I was led to believe, from the reading of English journals, that the quantity of tar produced per ton of coal was about 11 or 12 gallons, or 10 or 10½—somewhere along there. I swallowed that for years, and never measured it. I supposed, of course, it must be all right. In 1868, when I went to Portland, I put in operation a different process, and commenced getting a greater yield. I supposed, of course, that the quantity of tar would run below that, and would not probably go above six or eight gallons per ton. I held that the more tar you produce the less gas you produce, and *vice versa*. When the other companies in the New England States were producing, as they were at that time, all the way from 3.80. I ran up to, I believe, as high as 4.85 and 4.90. I supposed that my tar was proportionately less than the amount produced; and I sold it at that time according to the old English standard of 12 gallons to the ton; but I did not think I was getting that amount of tar, and spoke about it; but our President said as long as our customers were willing to buy and pay for it at that rate, it was all right. I went on in that way until four or five years ago, when I began figuring upon the number of barrels of tar we used every year, and I figured up that we were making 17 gallons of tar per ton. We kept on in the same track until last year. Since that time we have been burning tar. I have frequently measured the amount required per bench of five retorts, and there is no question in my mind but that we produce over 16 gallons per ton of coal carbonized.

Mr. Cabot—I can state, from personal observation, day after day, and week after week, that all the tar we have produced will not average over 10 gallons to the ton, from Penn or Westmoreland coal; but I do not know what Mr. Yorke's measure may be. If I am testing anything I do not go by guess work but by measurement.

Mr. Yorke—I know that I differ greatly with my friend Mr. Cabot, as well as others, in reference to the production of tar. I know that he and many others say that their production is from ten to twelve gallons per ton. Where the discrepancy is, I am unable to say; but I am satisfied of the correctness of my figures so far as our works are concerned.

Mr. Neal—It seems to me that we have spent as much time as is profitable in the discussion of this question. We have some other papers to be read, one by Mr. Greenough, which I am sure you all will be pleased to listen to; and unless same of the members desire to continue the present discussion longer, I would suggest that Mr. Greenough now read his paper.

[To be continued.]

[Official Report.]

Third Quarterly Meeting of the Central New York Gas Engineers Association.

Held at Rochester, N. Y., Thursday, February 19th, 1880.

(Continued from page 108.)

Mr. Harrington, of Niagara Falls, read the following paper on—

NAPHTHALINE.

Mr. President and Gentlemen—At the request of our worthy Secretary, I have prepared a few remarks upon the subject of naphthaline.

In choosing this theme for my paper, my object is to open a debate that may be of interest and assistance to us all. It is not my purpose to give a chemical analysis of this troublesome deposit, but to present a few facts as they have presented themselves to me, and my mode of treatment.

My first experience with naphthaline occurred about July 1st, 1876, shortly after the introduction of a stem jet exhauster and surface condenser into my works.

The first trace of this deposit occurred in a two inch service pipe used in supplying one of our largest hotels. Upon examination, I found the service cock filled with naphthaline. By the use of a service pipe cleaner I injected about a pint of naphtha into the pipe, which entirely removed the trouble; this service is about 2,500 feet from the works.

No further traces were discovered until August, 1877, at which time the same stoppage occurred again. I repeated the treatment mentioned, producing the same effect, lasting until the close of the season.

During the period referred to, Briar Hill coal was used, and not a trace of naphthaline was to be found about the works.

In the following year (1878) I began using Youghiogheny coal. During the season this service had to be cleaned three different times—traces of naphthaline presenting themselves about the works.

The drip at the washer being the most prominent point; but not sufficient to cause any serious trouble by increased back pressure.

During the year just passed my experience has been very unpleasant, as a sufficiency of cast-off clothing can abundantly testify.

For a period of three months, during the summer, it was a continual source of annoyance, from the lid on the mouthpiece to the burners in the most remote part of our district.

The principal stoppages at the works were in the stand pipes, and in a six inch main leading from the condenser to the washer. This main is laid under ground for 60 feet, dripping to the washer inlet, which is provided with the usual bye-pass valves, the inlet-valve being the first point of deposit gradually filling until completely closed.

This I attempted to remove by introducing steam with the gas, but found that it would congeal in the base of the washer before passing the drip.

After repeated attempts I found the only satisfactory method for its removal was to cease manufacturing and thoroughly heat all the connections, when it would pass off before congealing.

About this time the trouble presented itself in the purifying boxes, occasionally coating the first course of trays with large flakes, as it were, often one inch square, necessitating the change of a box to reduce the back pressure.

After succesfully battling with the locations named, still further honors were in store; thus far the inlet to the holder had escaped the fever.

Realizing the important part it sustained in connection with the works, it finally succumbed at 9 P.M.

Undoubtedly, the most favorable time of night for a public demonstration with only one holder available for use.

Not thoroughly satisfied with the public display, the next point for attack was in the principal street main supplying the Niagara Falls district, at which time the pressure was reduced sixty per cent. after locating the stoppage. I prescribed the same treatment as mentioned, furnishing temporary relief, having to repeat the operation daily.

Becoming convinced that the patient had no intention of submitting to the mild treatment, and having a small steam boiler and pump, I placed them on wheels, similar to a steam fire engine—starting for the seat of war in a very determined manner.

I introduced steam in the mains for about two hours, which most effectually removed the deposit, since which time the pressure has maintained its usual standard.

During the time I was operating upon the four inch main, the two inch service was not idle by any means, but was sustaining its reputation as a stopper of the first magnitude. Not satisfied in attacking this particular hotel at one point only, it began the attack upon the opposite side in a three-quarter inch service used for lighting some offices separate from the hotel proper—in fact, it actually stopped a five light meter.

Having at last, by the assistance of my steamer, removed the trouble from this location; and congratulating myself upon a cessation of hostilities, I was informed that other pleasures were in store, viz., the four inch main leading to Suspension Bridge had taken the liberty of presenting its case for treatment.

Meters were refusing to work under the light pressure incident to the obstruction.

Upon investigation, I found the main to be filled with naphthaline for a space of about five feet in length, and about 60 feet from where the other stoppage had occurred.

Between these two points is a four-way branch—the main from the holder leading directly into this branch. The obstructions in the mains have been on the north and south side of branch, while a service about 30 feet east of branch has caused considerable trouble.

My service experience has demonstrated that the general stoppages occur at the cock.

Query. Is there any chemical action between the brass and gas that would cause this formation; or is it caused by the cock being exposed to the air from the service box?

From my experience about works, it was with distrust that I began the use of steam in the street mains and services, but I have yet to see its evil effect.

I have endeavored, in the foregoing, to set before you some facts in establishment of such a substance.

As to its cause of formation, that I submit to parties more experienced than the subscriber.

In attempting to solve this difficult question, I have attributed it to various causes.

First. To the class of coal used; if such is is the case, why are not other works troubled in like manner?

Second. To the steam jet exhauster. The answer to the first is equally applicable to the second.

Third. Heats; this, to my mind, is the primary cause. From my experience our troubles have been most severe during the period when tar was used for fuel, producing very high heats; consequently, large yield.

Negatively, why can other works produce like yields, under similar manipulations, and not produce naphthaline?

I am at a loss to decide whether this formation is produced from the tar or from the gas. I have abundant proof that it will form in mains, etc., through which gas is actually passing after being freed from the tar, and I have further proof that it will form from tar where no gas is present. I have found it in large quantities in the ventilating pipe from the tar well, all gas being sealed off before reaching the well.

I have found deposits of naphthaline at a syphon drip at the outlet of station governor, the dripping from said drip solidifying on the pipe, forming a coating requiring a sharp blow of a hammer to remove. In this case there is no gas or tar in contact with the pipe except what may be held in solution by the water.

We are at liberty to attribute this deposit to any cause we see fit in connection with coal gas. But how are we to account for its formation in water gas, where anthracite coal and naphtha form the base of manufacture, naphtha being a solvent of naphthaline?

While in attendance at the meeting of the American Gas Light Association, held in New York in October, 1878, in company with several members of the Association I had the pleasure of visiting the Municipal works, at which time our worthy President formed one of the party. Mr. Bradley informed us he had been troubled with naphthaline to the extent of stopping a 20-in. inlet to his holder.

If gas in which naphtha, a known solvent, enters largely into its production, will develope naphthaline, is not the cause of its formation attributable to manipulation rather than material used?

In conclusion, I desire to tender my congratulations to those of you who have never experienced the troubles incident to this formation.

I desire to present one more subject for your consideration. Pardon me if I seem visionary. Is it possible that the drainage taking place by the production of oil is having any deleterious effect upon our coal supply?

By unanimous consent it was agreed that the Committee on Resolutions on the death of Mr. O. G. Steele, appointed at the last meeting, should be allowed to make their report.

Mr. White, for the Committee, submitted the following:

WHEREAS, He who ruleth the universe has, in his wisdom deemed it most fit to remove from among us an honest and tried associate, Mr. O. G. Steele, the late Secretary of the Buffalo Gas Light Company, it becomes at once our duty and sad pleasure to testify to our appreciation of his merits as an acomplished gentleman and upright business man; therefore, be it

Resolved, That the Central New York Gas Engineers' Association learns with profound regret of the death of Oliver G. Steele, Esq.; and while we must look upon his taking off as his eternal gain, a removal from earthly trials and sorrows to realms of peace, yet we cannot but lament the removal from our midst of so much that was venerated and useful in his daily walk and life.

Resolved, That these resolutions be spread in full upon the minutes of the Association as a memorial of our regard for the deceased.

CLEM. A. WHITE,
WM. CARTWRIGHT,
L. C. NORTH,

The report of the Committee was accepted and the Committee discharged.

The Association then adjourned to meet at 2 P.M., to take up and discuss the paper of Mr. Harrington on naphthaline.

[To be continued.]

Gaseous Fuel.

While the world is excited with the expectation of the success of the electric light, and other achievements of electricity, an economic revolution of even greater importance than the substitution of the electric light for gas light seems to be impending. We refer to the substitution of gas for solid coal fuel, especially for domestic purposes.

Theoretically, it is well known, it is more economical to obtain heat directly from the combustion of coal than indirectly from the combustion of gas, a product of coal which requires the consumption of heat in its own production. But practically, the indirect method of producing heat may be much more economical than the direct. It has already been found that in certain metallurgical processes, gaseous fuel is much more economical than solid fuel. This is true in general of all processes in which the most intense temperatures are required, such temperatures as are generated by the Siemens regenerative system. In puddling, for instance, from a ton to a ton and a half of coal is required per ton of iron in the ordinary furnace using soft coal, while in some forms of gas puddling furnace the coal consumption has been brought below one-half ton per ton of iron. Similar economy has been reached in the application of the Siemens furnace to melting steel in crucibles; and in the open-hearth steel furnace not only is gaseous fuel used with remarkable economy, but it is the only fuel which has yet been found to give the necessary temperature.

The two chief sources of the economy in use of gaseous fuel other than that arising from the intensity of temperature obtainable by it, are the ease and cheapness of handling, and the avoidance of waste. In convenience of handling there is no comparison between gas and solid coal. The former is transported in pipes; it may be from the mouth of the mine. The supply is regulated by simply turning a stop cock, and it leaves no refuse to be handled. In regard to waste the difference is quite as apparent. In using a coal fire, a much larger fire than is required for the purpose must be made, especially in domestic use, to avoid the risk of the fire's going out or of its being insufficient for its task, fuel must be uselessly burned before the fire reaches the point at which it becomes of service, and again after the service is performed there is useless consumption while the fire is going out. Then the ashes, which are not all ashes, but partly good coal, are left behind with not only the expense of getting rid of them, but with the waste of all the good coal contained in them. As for the waste heat passing up the chimnes, in all ordinary systems of heating for domestic purposes, it is simply enormous and a disgrace to our boasted civilization.—*Coal Trade Journal.*

Report of the State Inspector of Gas and Gas Meters, of the State of Massachusetts.

OFFICE OF GAS INSPECTION,
32 Hawley St., Boston, Jan., 1880.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts:—

The undersigned respectfully submits the following report:

The whole number of meters inspected during the past year was 5545; 5352 meters were either new or had just been repaired, the greater number being repaired meters; and if any of them were found to be incorrect they were returned to the manufacturers for readjustment and then tested again.

The number of meters brought to the office and complained of as incorrect was 193, the most of the complaints coming from the gas consumers. Of this number 83 registered against the consumer, the average error being 5 per cent.; 91 were within the limits allowed by law, namely, 2 per cent. either way; 18 registered against the company, the average error being 16.20 per cent.; and one meter would not register. The average error of all the meters about which complaints were made was .64 of 1 per cent. against the consumer.

One of the meters inspected was 220 per cent. slow; that is, if 320 feet of gas were passed through the meter, it would register only 100 feet. None of the other meters were as much as 10 per cent. slow. If this one meter were left out of account, the average of the meters complained of was 1.8 per cent. against the consumer.

All the meters inspected were "dry" meters. The results of the testings for previous years are given in the following table:

YEAR.	Meters.	Fast.	Meters Correct.	Meters.	Slow.	Total.	
		Per Cent.			Per Cent.		Per Cent.
1872	87	4.30	81	32	9.55	202	0.32 fast.
1873	100	5.43	95	40	6.61	238	1.18 "
1874	101	4.76	131	51	6.22	285	0.57 "
1875	123	5.99	142	39	8.17	314	1.33 "
1876	148	5.19	179	53	9.17	381	0.74 "
1877	93	4.79	125	34	11.00	257	0.28 "
1878	111	5.34	180	44	9.51	343	0.63 "
1879	83	5.00	91	18	16.20	193	0.64 "

In the following table the same meters are arranged according to the length of time from the first inspection to the re-inspection:

TIME.	Meters.	Fast.	Meters Correct.	Meters.	Slow.	Total.	
		Per Ct.			Per Ct.		Per Cent.
1 year or less.....	70	5.50	147	26	4.16	243	1.14 fast.
1 to 2 years	104	5.44	111	23	5.56	238	1.84 "
2 to 3 years	103	4.82	103	22	10.36	233	1.15 "
3 to 5 years	184	5.63	237	69	5.90	490	1.24 "
5 to 8 years	187	4.96	186	69	7.14	442	0.98 "
8 to 12 years	115	5.05	137	56	15.55*	308	0.94* slow
Never inspected, or more than 12 years.....	73	5.93	85	59	7.46	217	0.04 "

* If three meters averaging 150 per cent. slow were omitted, the percentages would be 7.80 and 0.55 fast, respectively.

A few meters that would not register were omitted in the second table.

It is by no means probable that the meters thus brought to the office were a fair average of those in use, as the meters under consideration were suspected to be wrong by either the consumer or the gas company.

Dry gas meters, if they are constantly employed in measuring well purified gas, and are kept at an even temperature, will usually remain correct for years; but if they are improperly used they must register quite incorrectly in a short time.

It is very desirable that every meter should be tested at regular intervals, say once in five years. A much shorter period would cause the gas company unnecessary expense, and a much longer period would render the inspection of no use to the consumer.

During the past year the authorities of Salem, Leominster, Southbridge, and Cambridge, have called on the inspector to make an official inspection of the gas in the towns named. In each case a careful inspection showed the gas to be more than four candles above the legal standard, twelve candles. At Leominster and Cambridge the gas was common coal gas of moderate illuminating power and fairly well purified. At Southbridge the gas was made of petroleum and then mixed with air, the air forming 47 per cent. of the mixture, which was found to have an illuminating power of 28.3 candles. At Salem a tolerably complete examination was made of a mixed gas with which it was proposed to light the city.

The gas was formed by passing steam over ignited coke, and then passing the "water gas" mixed with naphtha gas through retorts in which coal gas was being distilled at a low heat; and, finally, the mixture of gases and vapors was passed over a series of iron plates kept at a dull red heat, to fix the vapors.

The gas was tested with a flat flame burner, and also with Sugg's London burner No. F, and the results obtained were 25.6, and 24.9 candles respectively. The gas contained less than two grains of ammonia and only 3½ grains of sulphur per 100 feet of gas. Its specific gravity was 0.67 that of air. The eudiometric results are given in the following table, which also contains a few analyses of other kinds of gas. Quite a number of analyses are given in the inspector's reports for the years 1875 and 1877

KIND OF GAS.	Illuminants, $C_n H_{2n}$ &c.	Ethane, C_2H_6.	Marsh Gas, CH_4.	Hydrogen, H_2.	Carbonic Oxide, CO	Carbonic Acid, CO_2.	Nitrogen, N_2.	Oxygen, O_2.
Petroleum.	42.32	8.68	46.75	.....	.....	.....	2.08	0.17
"Kidder".. ...	8.74	.....	24.16	31.24	28.43	0.04	7.16	0.23
Boston.....	5.52	.....	45.09	43.88	4.82	0.25	0.44	.....

Besides the official inspections visits of inspection have been made to the places where there are disc photometers.

The results obtained show, in a general way, the quality of gas manufactured by the various companies; but as so few tests were made of any one gas, the results given may vary considerably from the true average of the gas for the year.

It should be stated that the reason why no more inspections were made was because they were not required by the law, and the inspector was obliged to pay his own travelling expenses. No notice has ever been given when the inspections were to be made.

The gas was burned from Sugg's London Argand-burner, at the rate of five feet per hour, and the light was compared with that from an English standard candle, burning at the rate of 120 grains per hour. If either the gas or the candle varied from the normal rate of burning, corrections were made on the supposition that the light produced was proportional to the amount of combustible consumed; but no observation was used in which the consumption of either gas or candle varied greatly from the normal rate.

The following table contains the observations referred to—

Name of Company.	Candle Power.	Number of grains in 100 feet of gas of— Sulphur.	Ammonia.
Boston.....	18.9	9.6	4.1
Brookline	17.8	7.1	7.5
Cambridge.....	16.5	9.1	8.3
Charlestown.	16.9	9.7	18.7
Chelsea	17.9	9.2	4.4
Dorchester	16.6	14.0	2.1
East Boston.....	17.1	8.5	18.0
Fitchburg	17.1	8.8	2.–
Leominster.....	16.3	8.9	1.6
Lawrence	16.8	6.6	20.0
Lowell.....	16.0	14.3	14.0
Newton*	....	10.9	37.0
Roxbury	18.5	7.2	5.5
South Boston.....	18.3	5.1	9.8
Springfield	15.9	14.1	2.–
Worcester	16.2	16.7	2.–

* Apparatus for removing the excess of ammonia is about to be erected here.

At Brookline, Cambridge, Chelsea, Dorchester, East Boston, Fitchburg, Newton, Roxbury, South Boston, and Worcester, the tests were made at the works; at the other places at some distance from the works. At the places mentioned the photometer was at the works, and so the inspector had to make his tests there; but it is generally desirable that the tests should be made at some distance from the works, so that the inspector may be sure that he is testing the same gas that is furnished the consumer.

The results obtained for candle power are satisfactory. The amount of sulphur in the gas is generally small, and the only place where an excessive quantity was found was in a works where iron oxide is the principal purifying agent. The gas of about half the companies contains an excess of ammonia; but no gas shows the great excess that was sometimes found in former years.

The present law governing the inspection of gas and gas meters was passed about 19 years ago, and great advances have been made in that time both in making and testing gas. To show that the gas has improved, it is only necessary to state that six years ago the inspection showed that, on an aver-

age, the candle power was below 15, and that the gas contained about 21 grains of sulphur and 36 grains of ammonia per 100 feet of gas. The inspection for the last year shows that the gas of the same companies now averages more than three candles better, and contains less than one-half as much sulphur, and less than one-third as much ammonia; but the greater part of the increase in candle power is due to using a better burner. In gas testing the apparatus has greatly modified, and some of it at present in use was unknown then.

The part of the law relating to testing meters has worked smoothly and seems to have given general satisfaction.

There are a few meters still in use that have never been inspected; and as probably a large portion of them are incorrect, I would recommend that the law should be modified so as to impose a fine on every meter in use after July first of the present year, that has not been inspected according to law. It should also be provided that when, for any purpose, the top is removed from a meter, before the meter is used again it shall be inspected as though it were a new meter.

A very few cases have come under my notice where the meters have been used without being inspected; the first of the proposed modifications would prevent such practices. As regards the second modification, it seems evident that a repaired meter needs testing just as much as a new one.

While the law provides fairly well for the inspection of gas meters, it is deficient as regards testing the gas itself. The present law specifies that "illuminating gas shall not be merchantable which has a minimum value of less than twelve candles," and the inspector is ordered to report whether it is sufficiently well purified from sulphuretted hydrogen, ammonia, and carbonic acid.

At present very few companies manufacture gas that is below fifteen candles, except by accident. It is evident that a standard of twelve candles is so low as to be useless, except that it enables gas managers to say, when told that their gas is poor, that it is above the legal standard. On the other hand, it is not desirable to set a very high standard for illuminating power; for in some cases it is desirable to employ gas as a source of heat and power as well as light, and for such purposes a rich gas is worth but little more than one having a moderate illuminating power. In order to be sure of keeping up to the standard, it is necessary to make the gas, on the average, about one candle better than the standard. All things considered, fifteen candles seems to be about the proper minimum.

All the coal gas at present manufactured is contaminated to a certain extent with various compounds of sulphur and ammonia. Probably there is not a sufficient quantity of these compounds present in ordinary purified gas to have any injurious effect on the health of persons. But it is, nevertheless, quite desirable to remove all but traces of these compounds. The sulphur compounds in burning, all give rise to sulphurous acid; or if burned along with ammonia to sulphuric acid, which is the final product in any case, as sulphurous acid, on exposure to the air, gradually changes to sulphuric. When present in any considerable quantity these acid fumes act injuriously on bindings of books, pictures, house plants, and other delicate objects. These effects are not observed with ordinary gas unless the ventilation is defective and the objects are exposed for some time. Unfortunately some of these sulphur compounds, as carbon bisulphide, are only removed with great difficulty; and 15 grains of sulphur per 100 feet of gas is as low a maximum as can be maintained. The English ganerally allow their gas to contain 20 grains of sulphur per 100 feet of gas; but their coals are rather worse than ours, and they do not use lime purification as extensively as we do.

The nitrogen of the ammonia compounds, when the gas is burned, is partly set free and partly burned to nitric acid. The ammonia in gas also corrodes brass fixtures and contracts the diaphragms of gas meters, causing them to register more gas than really passes. Fortunately, ammonia compounds are easily removed from gas by causing it to pass in thin streams over a sufficiently large surface of water.

The water used to wash the gas, sometimes contains as much as four per cent. of its weight of ammonia, and it is the chief source of the ammonia used in the arts. In Europe the ammonia is the source of a large revenue from this source. There bids fair to be a greatly increased demand for ammonia when the "ammonia process" of manufacturing carbonate of soda comes into general use, as there is every indication it will. Taking these facts into consideration, there is no good reason why more than traces of ammonia should be left in purified gas. The English allow only two grains of ammonia per hundred feet of gas, and the London gas generally contains only a fraction of a grain; but this standard of purity is more exacting than I believe to be really necessary; and if the gas did not contain more than five grains of ammonia per 100 feet of gas, there would be no cause for complaint. During the last few years the most of the companies have greatly reduced the quantity of ammonia in their gas, but there is a chance for still further improvement.

The only provision the present law makes for testing the gas is to direct the inspector to make tests whenever required by the mayor and aldermen of any city, or the selectmen of any town. There have never been many such requests; last year there were four. Such formal requests give the company sufficient notice, so that before the inspector can make his tests, the gas may be made much better than it was when the request for inspection was given. The proper method of making the inspections would seem to be, to have the inspector test the gas frequently, and at irregular intervals, so that the companies can make no unusual preparations.

As the inspector has to attend to testing the gas meters, as well as the gas, about as much as he could do would be to test the gas of the larger companies about once in two months, and the other gases once a year. Even this would cause him to be absent from the office a large part of the time. To have a satisfactory inspection there should be an assistant inspector, and the inspections could profitably be arranged as follows—

Every company supplying fifty or more consumers to have its gas inspected twice a year, and to have an additional inspection for every four million feet of gas manufactured.

This scheme would give from five to six hundred inspections a year, and would be about as much as two inspectors could do. It should be provided that the inspector should personally perform at least one-fourth of the inspections made at any one place.

Every company manufacturing fifteen million feet of gas per annum should provide a suitable room, near the centre of gas consumption, and a photometer of a design and construction approved by the inspector.

Provision should be made for travelling expenses, and the chemicals used in inspection.

CHARLES W. HINMAN,
State Inspector of Gas and Gas Meters.

Light and Heat.

We have referred frequently to Prof. Hummiston's system of generating heat and light from the products of petroleum, as exhibited the last six months at the store and shops of Messrs. J. P. Wood & Co., 41 South Fourth St., Philadelphia, and for the past month at Messrs. Bissell & Co.'s store, 235 Liberty street, Pittsburgh.

From a personal examination of its merits in heating, generating steam, cooking, and manufacturing gas for lighting purposes, for a long series of tests, it fully realized all that the inventor has claimed for it, perfectly filling our ideas of heat and light for domestic purposes. In broiling, boiling, or baking we have never seen it equaled, being instantly kindled, without smoke, ashes, or danger; easily controlled, giving a large bright or slow fire, as needed. In the cooking range we saw beefsteaks perfectly broiled in two minutes, the tea kettle boiled in three minutes, and biscuits baked in two and a half minutes, the same fire supplying gas for lighting purposes, which was stored in a holder until needed.

For an open grate fire in parlor or sitting room it is the easiest managed, cleanest, and most cheerful that could be desired. Insurance men commend the system as safe—even more so than the use of common city gas. This seems to be well demonstrated and explained by the inventor.

In our larger cities and all markets where the products of petroleum can be easily obtained, the system must prove economical in the cost of materials used, as well as in the labor required in its use. Heretofore it has been thought that such a fuel was adapted to summer cooking and kitchen work only, but in this invention we have a full provision for all seasons, for winter the saving being greater than for the warmer weather.

The cost of adapting the invention to general uses looks to be but little more than the common stoves and ranges.—*American Manufacturer.*

To Saponify Petroleum Oils.

According to the London *Journal of Applied Science*, the following is the practical mode of operation in the particular case of a refined petroleum: Stearic acid is the fatty matter employed, and, upon being melted, is poured into the petroleum—in the proportion of about 15 parts of fatty acid to 100 of petroleum After thorough intermixture has been effected by stirring, the mixture may be saponified in the usual way. It is recommended, however, that animal or vegetable fatty matter be added to it before saponification, the result being an improved product, the proportions recommended being 2 of acidified petroleum to 3 of fat. Either soda or potash may be used in saponifying, and the soap produced will be hard or soft according to the alkali employed and the proportions taken. The product is represented to be actively detergent, and to be free from tendency to putrefy. We give the foregoing for what it is worth. From the neutral chemical character of the mineral oils, it would appear that the result of the operation just described would be simply a case of mechanical suspension, and not one of chemical union, as in the case of the soaps proper. The process is affirmed to be applicable not only to the native mineral oils, but likewise to such as may be obtained from schist, asphaltum, and other sources.

THE AMERICAN GAS LIGHT JOURNAL AND CHEMICAL REPERTORY

A. M. CALLENDER & CO.,
PROPRIETORS.

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THIS IS a recognized official organ of—
LIGHT, HEAT, STEAM, WATER-SUPPLY,
VENTILATION, SANITARY IMPROVEMENT,
AND GENERAL SCIENCE.

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TUESDAY, MARCH 16, 1880.

Official Report of Examinations of Gas for three Weeks ending March 6, 1880, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

Feb. 1880.	Time of Day at which Test were made.	New York Gas Light Co.	Manhattan Gas-Light Co.	Mutual Gas-Light Co.	Metropolitan Gas-Light Co.	Harlem Gas-Light Co.	Municipal Gas-Light Co.
		*	*	†	*	*	†
16		21.82	19.49	24.84	18.16	17.02	30.55
17	Between	21.56	18.83	25.06	18.83	17.21	30.17
18	9.30 A.M.	20.28	19.13	25.56	19.17	17.08	31.04
19	and	21.46	20.46	26.69	19.34	17.27	30.84
20	1 P.M.	20.98	19.68	27.34	20.45	16 62	30.46
21		20.39	19.62	26.52	19.79	17.03	28.85
	Average	21.08	19.53	26.00	19.29	17.07	30.31
24		19 84	20.13	28.54	18.59	17.60	31.33
25		20.11	20.09	28.87	18.67	17.31	31.66
26		20.34	20.19	28.54	18.33	17.12	31.83
27		19.75	19.68	27.50	18.80	17.13	30.01
28		18.06	19.49	27.83	19.31	16.91	30.41
	Average	19.62	19.91	28.25	18.74	17.21	31.05
Mar.		22.23	20.40	27.32	20.14	18.10	30.57
2		20.40	18.93	27.64	21.64	17 54	30.36
3		20.67	19.32	27.68	21.24	17.25	30.22
4		19.69	18.84	27.32	21.32	17.40	30.56
5		21.81	19.51	26.87	21.25	17.55	31.83
6		20.52	19.82	28.52	21.85	18.09	30.73
	Average	20.88	19.47	27.56	21.24	17.65	30.71

* Five foot lava tip with check.
† Bray's slit union, No. 7.

E. G. LOVE, Gas Examiner.

Correspondence

[We are not responsible for the opinions expressed by Correspondents. Correspondents, in all cases, should sign their communications with their names and address in full—not for publiction, unless desired, but as a guarantee of good faith.—ED.]

Carbonic Oxide.

Mr. Editor:—In your issue of the 21 inst. your correspondent, "Coal Gas," says: "Mr. Allen attempts to show that carbonic oxide contained in water gas is not poisonous, from the fact that a young man survived after remaining for twelve hours where there was a small per cent. of his (Mr. Allen's) so-called water gas."

When "Coal Gas" was about it, why did he not say that Mr. Allen attempts to show that his water gas is more healthy to live in than air? That would have been a little broader, but when one volunteers to misrepresent another why mince the matter?

The first paragragh of my article referred to shows that I was replying to the charge that water gas contains "a blood poison, and that persons inhaling it cannot be revived or escape its effects by an exposure to the open air, as in case of coal gas;" and I cited the case referred to, and another similar to it, as proof that the charge was unfounded.

But "Coal Gas," referring to the young man, says: "Why he did not open the door is not stated" No, I only quoted the editorial in the Poughkeepsie *Daily Eagle*, giving the particulars, which stated that "the occupant of the room was found lying upon the floor in an unconscious manner." Does "Coal Gas" claim that if one becomes unconscious from inhaling coal gas he will get up and open the door? Or does he claim that coal gas is not poisonous, or that no one ever becomes unconscious or dies from inhaling it? And would I be justified in saying that he attempts to show that?

But "Coal Gas" takes another tack, and runs head on upon another rock in open sight. He says: "The circumstances show that either the young man inhaled but very little of the gas, or there is very little if any water gas remaining in that made under the Allen-Harris Process when it reaches the consumer, as has been claimed by those who have analyzed it. I think the latter theory the correct one."

My reply is, first, if one can lie for twelve hours in a small room, with our gas flowing in from a four-foot burner, and inhale but very little of it, then, practically, such gas is not dangerous, for people will not be at all likely to blow out the gas from more than one four-foot burner in a room of that size, nor to let it run more than 12 hours at a time. Second, the company that made that gas under the Allen-Harris Process makes about twenty million cubic feet per year of precisely the same gas; and all of it is pure water gas except so much as comes from about four gallons of naphtha to each 1000 feet, to give it illumination. If, then, there is very little or no water gas in it when it reaches the consumer, it must be pure, or nearly pure oil gas. But it is well known that pure oil gas can be burned only in one-foot burners, or it will smoke; and yet the people of Poughkeepsie have been burning our gas with four, five, and six-foot burners for nearly five years, and when it reaches them throughout the city, and also the State Hospital, three miles from the gas works, it furnishes a more brilliant and satisfactory light than any coal gas. As four gallons of naphtha make only about 280 feet of gas, and there is nothing else but pure water gas put into the holder, the remaining 720 feet in every 1000 feet delivered to the consumers must be water gas.

Those analyzers in whose theory "Coal Gas" believes must be twin scientists to the assayer of ore in the gold regions. The story is, that an old miner suspected that his assayer was not reliable, and so he tested him. He took a potato, dried it thoroughly, pulverized it, and delivered it for assay. The assayer reported the yield in gold at the rate of $40 per ton.

Now "Coal Gas" may just as well believe in that result as in the theory of those analyzers who claim that "there is but very little, if any, water gas remaining in that made under the Allen-Harris Process when it reaches the consumer." H. P. ALLEN.

NEW YORK, March 5 1880.

"The Inventors' Guardian" Upon Heavy Gas Bills.

Ignorance is the real cause of heavy gas bills. We go on blundering and shutting our eyes and ears to every innovation, and then grumble at the cost of our neglect. The following experiment recently carried out for an officer of the Board of Trade, should open our eyes to the truth. Two burners were selected for comparison, (1) an ordinary burner, (2) a Sugg Christiania with patent governor. It must be remembered that the pressure usually varies in the mains from eight-tenths of an inch at daylight to two inches at night—the period of maximum demand. The effect of the ordinary burner under these variations was as follows. Lighted at sundown the consumption was five feet an hour, giving six candles, and as the pressure increased to seventeen-tenths, the consumption being over eight feet, the illuminating power, which never exceeded nine candles, actually declined to six and a half candles. Thus the illuminating power gained by nearly double consumption was only one and a half candles. Under similar variations of pressure the Sugg Christiania burner maintained throughout a steady light of 15¼ candles, the consumption never exceeding five cubic feet an hour. This explains why our gas bills increase from 20 to 50 per cent.

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.
(with W B Scott & Co.,)

24 PINE STREET, NEW YORK CITY.

MARCH 16, 1880.

☞ All communciations will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid.	Asked.
Gas Co.'s of N. Y. City.				
Central	466,000	50	50	60
Harlem	1,800,000	50	50	60
" Bonds	170,000			103
Manhattan	4,000,000	50	167	170
Metropolitan	2,500,000	100	125	130
" Scrip	$1,000,000	...	99	102
Mutual	5,000,000	100	60	70
" Bonds, gold	900,000	1000	95	100
Municipal	1,500,000	100	190	205
" Bonds	750,000		106	110
New York	4,000,000	100	106	110
Northern	270,000	50	—	100
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	116	120
Citizens	1,200,000	20	55	60
" S. F. Bonds.	320,000	1000	100	105
Peoples	1,000,000	10	25	30
" Bonds.	290,000	...	90	95
" Scrip	250,000	...	75	85
Metropolitan	1,000,000	100	60	70
Nassau	1,000,000	25	50	55
" Ctfs.	700,000	1000	85	95
Williamsburgh	1,000,000	50	70	75
" Scrip		...	97	101
Kings Co	135,000	100	—	50
" Bonds	40,000	—	—	—
Union Co. E. N. Y.		25	—	50
Richmond Co., S. I.	300,000	...	—	85
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N.Y	750,000	100	65	70
" Bonds	200,000	1000	95	100

Baltimore, Md.....	2,000,000	100	95	98
" Ctfs., gold	1,000,000		—	103
Bayonne, N. J.....		100		90
Brockport, N. Y.....	25,000	100	...	80
Citizens, Newark.....	918,000	50	85	90
" " Bds.	124,000	—	105	10
Chicago Gas Co., Ills			125	—
Cincinnati G. & C. Co.				190
Derby of Conn.....	160,000	100	60	80
East Boston, Mass...		25	114	120
Elizabethtown, N. J.	300,000	20	—	130
Fort Wayne, Ind.....		100	...	—
Hannibal, Mo.....	100,000	100	95	100
Hartford, Conn.....	700,000	25	120	125
Hempstead, L. I.....	25,000	100	...	—
Halifax N. S.....	400,000	40	148	150
Hamilton, Ontario...	150,000	40	117½	
Jersey City	750,000	20	140	145
Jamaica, L. I.....	25,000	100	...	—
Jacksonville, Ill.....	120,000	50	100	...
Lewistown Maine...	400,000	100	70	80
Laclede St Louis Mo.	1,200,000	100	93	96
Long Branch..		20	30	40
New Haven, Conn...		25	120	140
Peoples, Jersey City		...	40	50
" " Bds.				95
Peoples of Albany...	650,000	100	—	10
" Bonds	350,000	1000	—	-
Peoples of Baltimore		25	80	84
" Bonds....			106	—
Plainfield, N. J.....	80,000	100	—	105
Perth Amboy		25	—	95
Pittsfield, Mass.....			120	130
Rochester, N. Y.....		50	70	80
" Citizens		100	50	60
Rondout & Kingston			75	80
St. Louis Missouri..	600 000	50	300	—
Stillwater, Minn.....	50,000	50	—	26
Saugerties, N. Y	15,000	100	95	100
San Francisco Gas-Co., S. Fr'sco Cal.			81¾	82
Toledo, Ohio..... . .			95	97
Troy, Citizens.....	600,000	100	—	—
Washington, D. C...	1,500,000	20	170	185
" Scrip	500,000	20	100	110
Woonsocket, R. I....	150,000	100	80	...
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Complete Gas Works
FOR SALE.

The Iron Work for a complete Gas Works, with 8 inch connections, consisting of 4 Purifiers, 8 ft. by 10 ft., with Dry Centre Valve, Multitubular Condenser, Scrubber, Bye-pass Valves, 5 feet Station Meter, and Bench Casting for four benches of 5's. All nearly new, and in good condition.

THE MUTUAL GAS LIGHT CO.,
497-tf ST. JOSEPH, MISSOURI.

NOTICE OF DISSOLUTION.

NOS. 1115 AND 1117 CHERRY ST.,
PHILADELPHIA, Feb. 25, 1880.

On the 1st day of January, 1880, the firm of HARRIS, HELME & MCILHENNY, Gas Meter Manufacturers, was dissolved by mutual consent, by the retirement of WASHINGTON HARRIS. The business will be continued at same place, **1115** and **1117** CHERRY STREET, by the remaining partners, WM. HELME and JOHN MCILHENNY, under the firm name of HELME & MCILHENNY.

WASHINGTON HARRIS,
WILLIAM HELME,
JOHN MCILHENNY.

Upon retiring from a business, my connection with which dates more than the third of a century back, I embrace this opportunity of extending my thanks to the numerous friends and patrons who kindly favored me with their patronage and friendship through that long series of years.

Asking respectfully for the remaining members of the firm a continuance of this friendship and patronage I remain,

Respectfully yours,
497-2t WASHINGTON HARRIS.

WATER GAS.

Strong Gas-Fuel and Light Co.,
No. 120 Broadway
(EQUITABLE BUILDING), NEW YORK.

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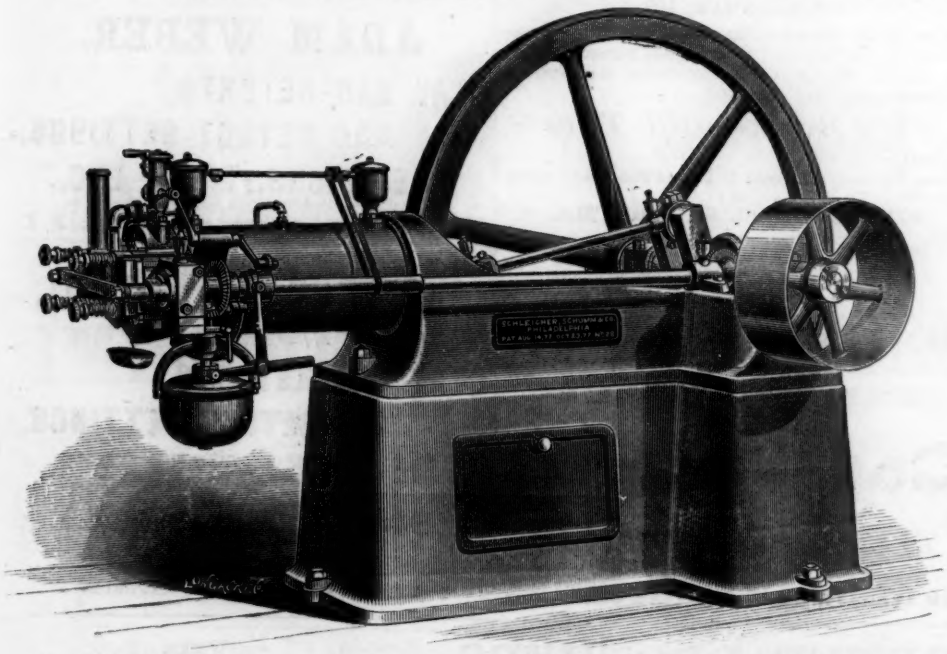

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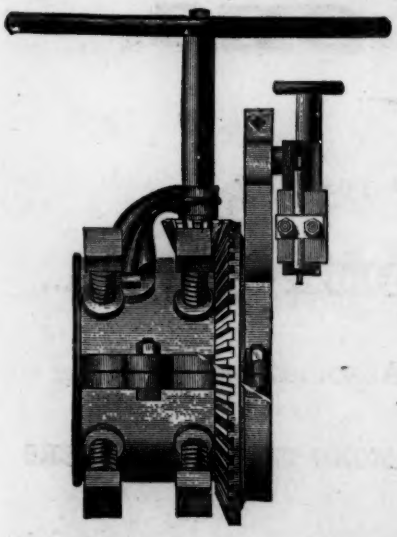

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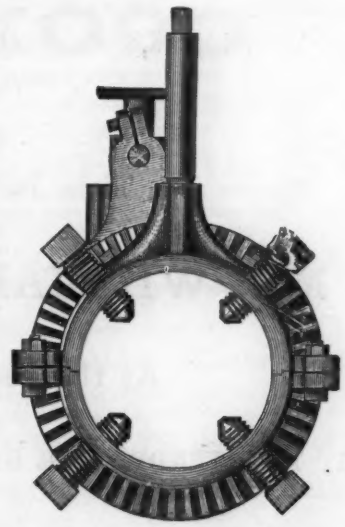

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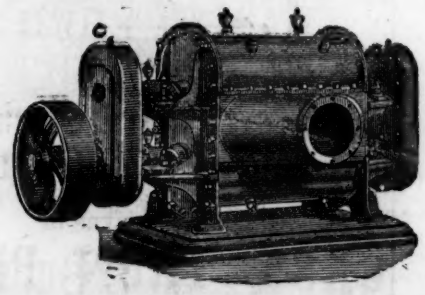

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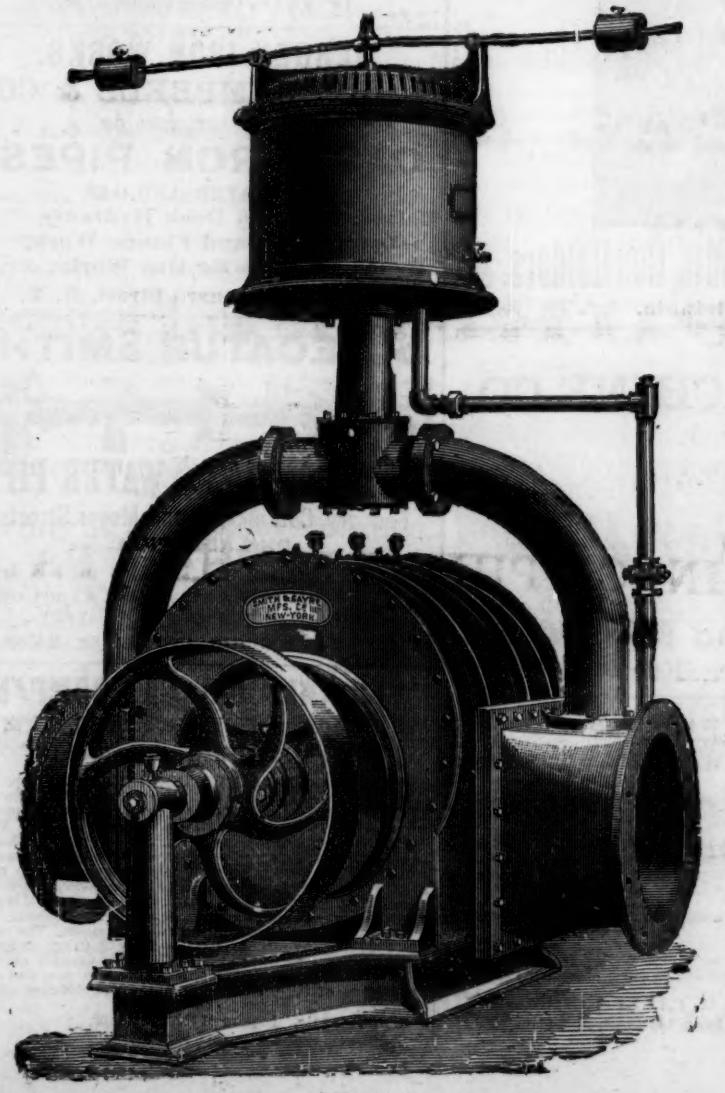

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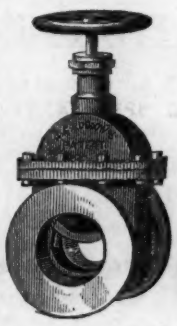

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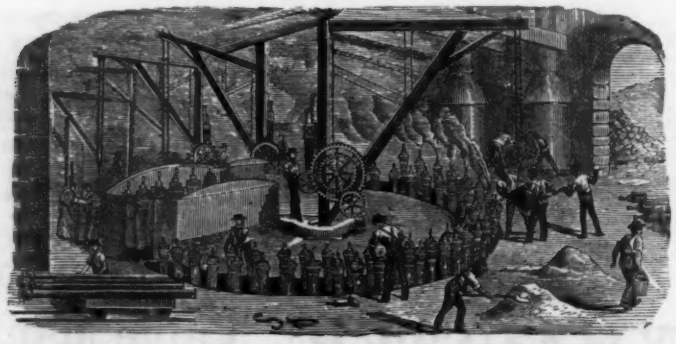

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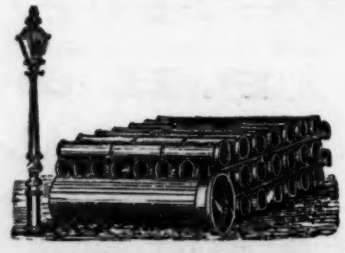

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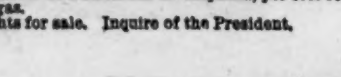

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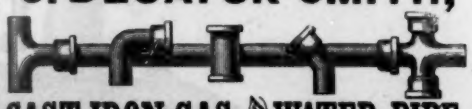

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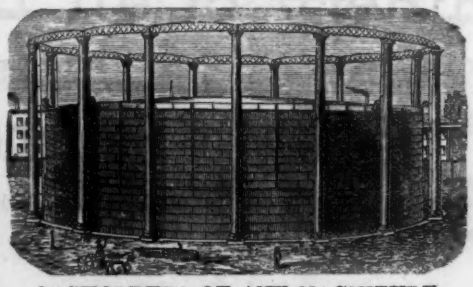

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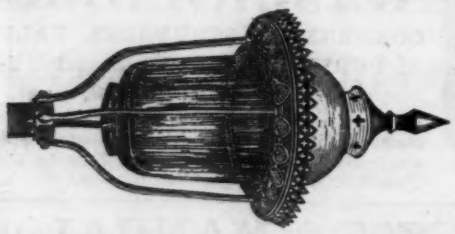

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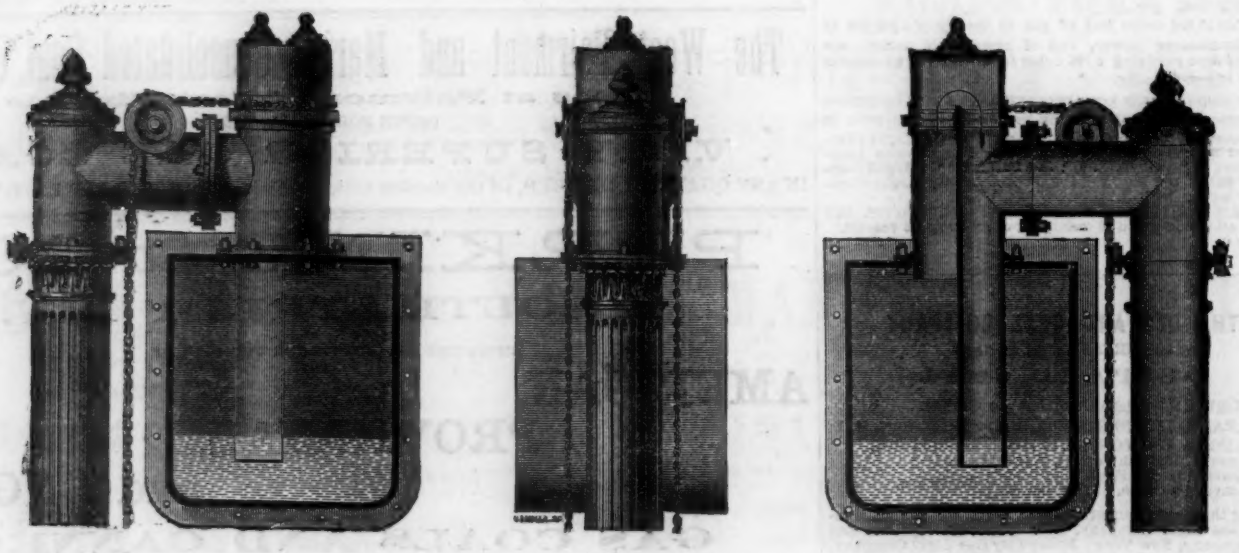

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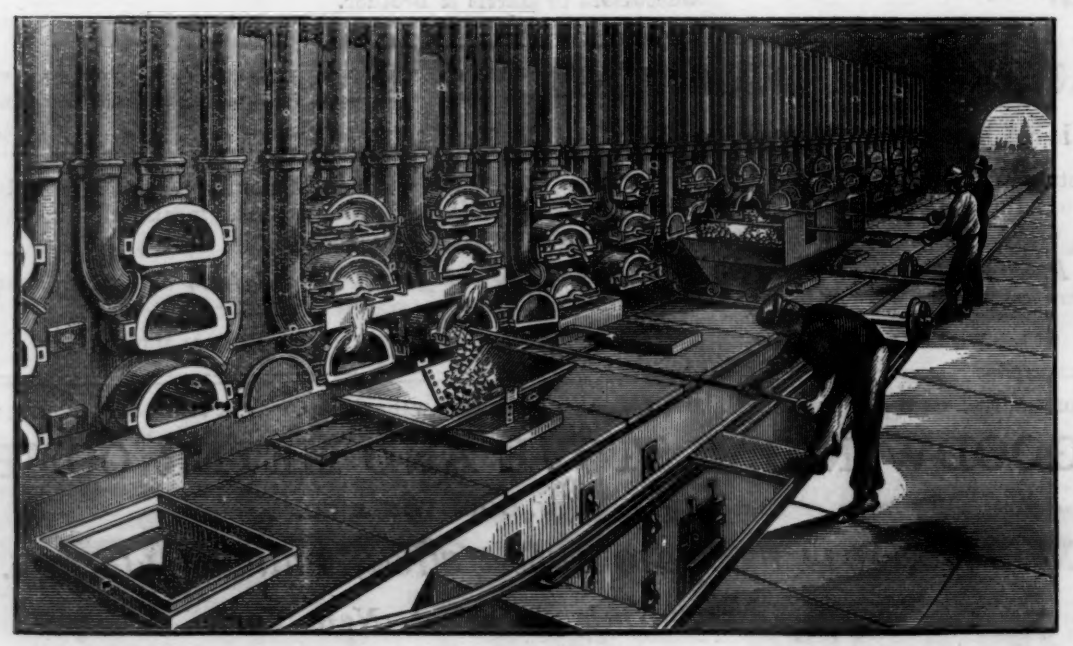

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